Reading Two

FOOD AND CULTIVAR PRESERVATION IN MICRONESIAN VOYAGING

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INTRODUCTION

This paper will attempt to deal with the problem of food transportation and preservation in Micronesian voyaging and also with the problem of transportation of cultivars (Defined as "an organism of a kind [as a variety, strain, or race] that has originated and persisted under cultivation." Webster's Third New International Dictionary) The Polynesian outlier Kapingamarangi is included in this survey as it is in the same general geographic area.

Proto-Micronesians migrated into the Marshalls, Gilberts, Carolines and Marianas, successfully island hopping and eventually covering an area of over 4,000 square miles. They brought food and cultivars with them. Today, even though modern shipping operates throughout Micronesia, voyaging by natives in native craft is still taking place (Gladwin 1970). In discussing today's Micronesian voyaging, it would not be difficult to imagine that today's methods of food preservation and cultivar transportation are similar to past practices, discounting, or course, any modern technological methods that have crept into use. (In my reading I found mention of metal coconut graters made by nail holes punched in sheets of tin. I found no mention of refrigeration or preservatives in any of the descriptions of food preparations.)

It is immediately apparent that there is little written on the subject of provisioning for voyages in pre-contact days. A contemporary and very useful source for this paper was Some Tropical South Pacific Foods, by Murai, Ben and Miller, (1958). Carey D. Miller was

the head of the Foods and Nutrition Department for the Hawaiian Agriculture Experiment Station and was the senior authoress of the book, and thus I will refer to Miller (1958) throughout this paper. The book discusses food preparation and preservation and nutrative values in the islands of Micronesia, specifically the Marshalls and Carolines. For information on the Gilberts I relied on Arthur Grimble's "Migrations of a Pandanus People" which appeared as memoirs in a supplement to the Journal of the Polynesian Society, (1933). Further sources were Sir Peter Buck's Material Culture of Kapinga-marangi, (1950). I often referred to Gladwin (1970) in order to get a general feel and picture of Micronesian voyaging. Mr. Donald Anderson of the Lyon Arboretum graciously spent a morning with me describing his canoe voyages in Fiji, the Tuamotus and Central Carolines. This was the only material that I could find on the transportation of cultivars. I attended the Kualoa Workshop in October, 1975 and heard lectures by Paige Barber and June Gutmanis, two of the women who are preparing food for the Polynesian Voyaging Society voyage.

Micronesian voyaging is like island hopping when compared to the Hawaiian-Tahitian migrations. Micronesia is an area with both low and high volcanic islands and atolls. According to Gladwin's experience, trips of several hundreds of miles have been under-taken, although the trips are usually shorter than that. In either case rarely were the voyagers out of sight of land for any signifi-cant length of time. Thus, food preservation and transportation of cultivars does not become a critical factor.

Micronesian weather is seasonal and subject to hurricanes and typhoons. Thus, there are periods of plenty and periods of want. Preservation of food becomes a necessity of everyday life. As with many other primitive peoples, the Micronesians had a diet limited to a few foods. Through generations they worked out a diet of food which their islands could support. That their diet was adequate is indicated by the comments of the early explorers concerning their good teeth and physical condition. Buck (1950) believed that when the people of Kapingamarangi cultivated and ate their own food their nutrition and their vitality was better than those who ate "civilized food". Some nutritional deficiencies were found by the Alpert Report (1940), but Miller (1958:2) feels that this is due to interrupted native diet due to the war and several generations of Western and Oriental influence.

In reviewing the literature it becomes apparent that the Micronesian diet consists primarily of breadfruit, coconut, Cyrtosperma and pandanus. Other less eaten foods such as banana, apuch (Crataeva speciosa) and arrowroot will not be considered here.

BREADFRUIT

Breadfruit is one of the basic foods of the natives of many tropical islands and in the Marshalls and Carolines it is preferred to the starchy aroids. It has played such a role in their lives that many Pacific ethnic groups have accounts of the creation of breadfruit in their folklore.

The breadfruit species is native to Malaysia and belongs to

the Moraceae family. The same family contains the figs and banyans, although they are of different genera. Breadfruit offers a variety of ethnobotanical uses to the Micronesian, but our interest here is in its food uses and values. There are varieties of breadfruit within the species Artocarpus altilis. Some have small seeds, some large and some are seedless. Breadfruit has less tolerance to salt soil than does pandanus or coconut. Miller (1958:9) states that the distribution of productive breadfruit closely follows the pattern of salinity in the ground water. Miller (1958:9) also states that in a personal interview, Dr. Kenneth Emory said that the seeded variety is hardier and will grow better on a coral atoll. Dr. Emory believes that "the seeded breadfruit is a more valuable timber tree as it attains a far greater height", with a straighter trunk.

Breadfruit was named by William Dampier who first saw it on Guam in 1686 and wrote that, "The breadfruit (as we call it) grows on a large tree, as big as our largest apple trees... There is neither seed nor stone in the inside but all is of a pure substance like bread."

In the seeded varieties the seeds are also cooked and taste like chestnuts. The seedless varieties are eaten only in the cooked state. The seeded varieties can be eaten without cooking.

The length of the breadfruit season is influenced by the location and latitude and type of island (volcanic or atoll), the part of the island and the variety grown. However, in general it could be said that the season begins in May, peaks in August and

ends in December. In the southernmost islands of Micronesia the season lasts more or less all year long. Starchy aroids and pandanus flour are used in between.

Miller (1958:15-17) refers to native names of methods of cooking ripe and green breadfruit in some detail. One method used by the Trukese is of interest. Cooked mature breadfruit is scraped and pounded and made into kon by the men. They pound the breadfruit on a board with a pounder made of coral rock, the shape being very similar to Hawaiian poi pounders. The men pound enough kon to make a loaf weighing 8 or 10 pounds. The loaves are made into meat bundles by binding them with breadfruit, banana or taro leaves. Kon may be eaten the day it is made or it may be stored. By the fifth or sixth day it begins to ferment and can still be eaten, although it is preferred fresh.

During the breadfruit season kon is the most important food of the Trukese. Men and women carry it in bundles on their heads as they walk along the roads. In Truk, food is not given to travelers unless they are of the same clan, so they must take their own food as they travel about. According to Miller (1958:16) the Trukese also take leaf wrapped packages of kon on their native boats.

Preserved breadfruit in the Marshall Islands is called bwiru. The following description from Miller (1958:18) is extracted from Dr. Leonard Mason's field notes taken in 1950. The uncooked mature breadfruits are scraped with a shell scraper. The fruits are cut in two lengthwise and the cores are removed and discarded. Batches of the cut fruit are placed in sennit nets and immersed in salt

water in the lagoon or the ocean side. The bags are anchored with a piece of coral to keep them from floating away. They are left there for a day and a night. The fruit is then taken from the water, piled on the ground and covered with palm fronds. It remains there for two days and two nights until it becomes very strong smelling and soft. The breadfruit is squeezed between the fingers to make a doughy mass. This mass is sprinkled with fresh water and stirred once a day for 3 days. It is now called bwiru. The bwiru is placed in a pit lined with dried breadfruit leaves and palm fronds and left for about 2 weeks before using. By changing the leaves daily and later weekly, the bwiru can be kept for as long as two years. The bwiru is removed from the pit as needed and is washed and cooked before using.

Several dishes are made by the Marshallese out of the bwiru. In the preparation of manakajen the bwiru is taken from the pit and compressed on coconut fiber in slabs and left in the sun to dry. In appearance it is gray-white and resembles slabs of clay. In a week it becomes very hard. In this form it will keep indefinitely, thus forming an excellent emergency food. In order to keep it clean and insect free it is wrapped in plaited pandanus bundles and stored. Miller (1958:32) states that a slab of manakajen was loosely wrapped in a piece of waxed paper and stored on a laboratory shelf for three years without any signs of deterioration. Manakajen can be reconstituted by being broken into small pieces and soaked in water overnight. It is washed in several changes of water and drained. Then it is kneaded on a board until it

becomes a sticky mass and is used to make Marshallese dishes of ieok, chubwe and bitro, the recipes for which are listed in Miller (1958:21). These dishes are immediately perishable. For this paper we will restrict our discussion to recipes of preserved breadfruit.

In the Carolines a preserved breadfruit is made called apot. The mature breadfruits are scraped and left on the ground overnight covered with banana leaves. A pit 2 feet by 5 feet square and 2 feet deep is dug in the earth and lined with 3 or 4 layers of banana leaves. In the pit are placed several hundred breadfruit and they are covered with leaves and weighted down with rocks. When the pit is opened 2 or 3 months later the breadfruit is an homogeneous mass of fermentation with a strong odor. The mass may be left in the pit for as long as a year with the needed portions being removed from time to time.

From the apot the Carolines people make apot mei mon and apot mei pupu which are immediately edible. It is not reported that the Carolines people make an intermediate stage of dried breadfruit as the Marshalles do with their manakajen.

In Material Culture of Kapingamarangi, Buck (1950:36) gives a detailed description of the preparation of preserved breadfruit or pakukura. The women peel the green mature breadfruit with shell scrapers or use their teeth if it is very ripe. The fruit is cored and torn into lumps and packaged in breadfruit leaves and tied with dry pandanus leaves. These leaf packages are placed in an earth oven for two hours. The next day the packages are opened and

emptied into a bowl. The women mash the contents into a yellow paste. This mass is spread out by hand in the sun on mats of green woven coconut leaves. The women go over the past carefully removing any lumps. After several hours the paste is turned to dry on the other side. At this point the men take over and roll the breadfruit paste into packages of pandanus leaves tied around with 2 ply cord. The packages when finished, as recorded by Buck (1950:38), are 19 inches long and 3.8 inches in diameter. This preserved breadfruit is said to keep a long time and is used as a reserve food and a suitable provision for a long voyage at sea. As needed, one end of the roll is opened and the desired portion is cut off.

Miller (1958:31) devotes several pages to the composition and nutrative value of breadfruit in various stages of maturity, cooked and uncooked. She states that breadfruit may supply all the caloric needs of a moderately active islander. One thousand grams of breadfruit a day would supply one-fifth the protein, one-fourth the calcium, almost all the phosphorus, more than half the iron, negligible amounts of provitamin A, one-half to two-thirds of the thiamine, about one-half of the vitamin C needed. Fish and coconut would be required to supply the protein and fat. Some source of provitamin A would be needed, but pandanus, if in season, could solve that. Preserved breadfruit, because of the soaking, washing and pounding, has reduced the amount of water soluable vitamins. The dried preserved breadfruits would have considerable vitamin C loss, (Appendix: table 1).

PANDANUS

The pandanus is native to the Pacific. The tree is dioecious and the edible portion grows on the female tree. The pandanus is an important seasonal food in Kapingamarangi, the Marshalls, Gilberts and Ellice Islands. The pandanus fruitlets or keys contain a sweet juicy pulp that is eaten raw or cooked. A 30 pound fruit can have as many as 50 keys. This edible portion can also be preserved as a dried paste and as a flour. Pandanus, like breadfruit, is also prominent in the folklore of the Marshalls and Gilberts and is thought to have come to them at the time of creation. In the Marshalls each family owns several trees, cutting the fruits when they are ripe and processing them as desired. Pandanus is in season approximately from January to May.

The most common way of eating pandanus is to chew on the inner soft end. In the raw state the edible portion is a juicy liquid which is sweet and pungent. In the cooked state the starch causes the juice to thicken and the edible end becomes soft and pulpy, which as stated by Miller (1958:71) resembles mashed potatoes. According to Buck (1950:286) in Kapingamarangi the keys are cooked in an earth oven and eaten by hand. The dried eaten keys are stored and used for fuel. This might have some implications for fuel on voyaging canoes.

In the Marshalls a pandanus paste called mokan is made by cooking the pandanus keys in an earth oven for one or two days. The soft ends of the keys are scraped with a shell scraper and the orange colored pulp is collected and dried on leaves and further dried on

hot stones. Flat cakes are formed and pressed into a solid mass and wrapped in plaited pandanus leaves and tied around with coir cord in a way extremely similar to the methods used in tying up the breadfruit manakajen. The pandanus paste is brown in color and tastes like fig paste. It will keep a year or more and was important for use on voyages and in case of famine.

Pandanus paste is made into a flour in the Gilberts and in Kapingamarangi. Both Grimble (1933) and Buck (1950) give detailed descriptions of the manufacture of pandanus flour. In Kapingamarangi, according to Buck, the pandanus paste cakes are allowed to further dry and when completely dry and hard they are beaten and pounded on a board until a fine powder is formed. This pandanus flour could be kept and used as desired, at which time it is mixed with water to make a porridge.

In the Gilberts, according to Grimble (1933:36), the pandanus flour, called kabubu, is made from pandanus paste with great care taken to expell every possible amount of moisture as the keeping qualities depend on the amount of desication. When the slabs are completely dry they are broken up into bits and thrown into a giant Tridacna shell and pounded into flour with a wooden pestle of pemphis wood. The resulting kabubu is packed into prepared tabular containers of pandanus leaf and will keep for as long as two years. This is one of the most sustaining foods known to the Gilbertese and according to Grimble (1933:39) was an ideal food for voyages in the early days. "As long as a canoe's company had kabubu and water they could venture on a voyage of any length."

The nutrative value of pandanus paste contains little or no fat or protein, and is about 18 percent carbohydrate. The carotenoid pigments which color the fruit a red-yellow may be the only source of provitamin A available. It is not rich in thiamine and riboflavin and is a poor source of vitamin C. However, if eaten in large quantities the vitamin C and riboflavin and thiamine content could meet the needs of the body, the dietary requirements for which are calculated for a medium build person in a warm climate, (Appendix: table 2).

CYRTOSPERMA

In considering possible voyaging foods within the frame of referrence of this paper, Cyrtosperma and taro are obvious candidates. According to Barrau (1956:6), Cyrtosperma, a native of South East Asia, is the taro of the Micronesians. It grows well in a swampy situation and its yield is greater than taro, thus the Micronesians have largely replaced their taro with it, even though the taste and texture are inferior to taro. According to Buck (1950:281) Cyrtosperma was introduced into Kapingamarangi in post contact times by a European sea trader.

Cyrtosperma produces corms which may be harvested young, but can grow to enormous size. Nowhere could I find referrence to poi being made by the Micronesians out of taro or Cyrtosperma except from my interview with Mr. Donald Anderson from Lyon Arboretum. However, both the raw and cooked corms of both taro and Cyrtosperma would be excellent voyaging foods as they would keep for about two weeks.

Cyrtosperma and taro have about the same caloric value. The calcium content of the Cyrtosperma varies with the area of its cultivation. Cyrtosperma has less than half the thiamine than the taros, but the same amount of riboflavin and niacin. They have no provitamin A or vitamin C.

Alocasia, another Areceae is a much hardier plant, but is not popular and is eaten when other supplies of food are short. It does not have corms and the starchy stem is the portion eaten. It is of lower nutrative value than the other starchy roots, (Appendix: table 3).

COCONUT

The coconut, (Cocos nucifera) geographically dispersed throughout the Pacific, is generally thought to have been spread by man and ocean currents (Edmonson 1941). The coconut is extremely important to the Micronesians and every part of the tree is used. The unhusked nuts can be kept for many months and are edible at every stage including the sprouting stage. When taken on voyages the husks can be used as fuel.

A variety of foods can be made from coconut. Discussed here will be foods with preservation possibilities and thus having potential for use in long voyaging. Top consideration is given to the nut itself. Each stage of edibility of the nut is noted and named by the Micronesians. Grimble (1933:30) notes 17 different stages named by the Gilbertese.

As a drinking nut the coconut offers a clean cool beverage. The soft meat of the drinking nut is easily scraped out and is

often fed to babies. At the mature stage the coconut is grated and coconut cream is made to be added to a wide variety of dishes. Coconut embryo is a delicacy in the Marshalls and is best eaten 4 months after the coconut falls from the tree.

Coconut toddy or sap collecting is practices by Micronesians and Grimble (1933:33) describes Gilbertese preparation methods as follows:

> Toddy is the sap extracted from the coconut blossom before the hard spathe which contains it has burst. The tip of the spathe is cut off, exposing an inch or two of compressed unopened blossom. The spathe is then bound around with string, in the manner of a cricket bat handle, upward from the base to the cut-off end. A section of the exposed blossom is shaved off and the toddy oozes from the cut surface...a coconut shell suspended below the tip catches the sweet liquid.

The toddy ferments in about fifteen hours and is a popular intoxicant. However, according to Grimble (1933:34) a preserved food is made from it called kamaimai which is obtained by boiling the mixture to almost a solid state until it becomes the consistency of caramel. At this stage it is formed into a ball and set aside for storage. It is taken out when needed and pieces are sliced off. It is eaten as a relish and a sparing amount is considered enough.

The nutrative value of the liquid from drinking nuts is little or none. The mature meat is high in fat and low in protein. Minerals and vitamin content are low except for iron. Coconut sap or toddy is high in vitamin C and is recommended by Miller (1958:62) for children as the niacin and thiamine value are higher than mothers'

milk. The amount of calcium is not significant, but the iron content is fairly high, (Appendix: table 4).

OTHER FOODS

The Micronesian diet receives its protein from seafood. Little is recorded concerning the methods of drying fish, either for preservation in times of scarcity or for provisioning canoes for voyages. On the atolls perhaps this is because of the presence of lagoons and thus an availability of fish in all weather conditions, as well as ease in netting and trapping them. In looking at other sources of animal protein, the pig is considered to be an European introduction (Grimble 1933:29). However, fruit bats and large birds were hunted on larger islands. According to Buck (1950), on Kapingamarangi pigs are a post contact food and fowls are of little or no interest to the people there.

It is interesting to note briefly the absence in Micronesia of some cultivars which are strong parts of the culture among the Polynesians and Melanesians. Sago, which is a large part of the diet in Melanesia and grows wild in the river swamps, is used to prepare a starch which is made into cakes and keeps well for several months. According to Dr. Harold St. John (1973:9), the sago is cultivated as far north as Guam, but it is not utilized by the Micronesians.

Kawa or awa, which is a common beverage among the Polynesians, is reported by Barrau (1956:44) to be drunk only among a small population in the area of Ponape in the Carolines. The betal palm,

according to Grimble (1933), does not grow in the Gilberts, but is present in traditional legends which tell of ghosts eating the "red food."

Although this survey discusses preserved foods that can be readily eaten without cooking, there is evidence that food was cooked aboard voyaging canoes. That it is being done now in the Carolines is mentioned by Gladwin (1970:60) when he relates that a fire was made aboard a canoe albeit in an iron box filled with sand. Dodd's book, Polynesian Seafaring, 1972, states that the double canoes carried a sandbox forward and most likely a fire was kept going most of the time. Dodd contains two illustrations of Tongan canoes (Dodd 1972:73-74), one drawn by Tasman in 1642 and one by Shouten in 1616. Both depict billowing smoke from a fire on board. One fire is confined to a box and another appears to be out on the open deck. Hornell (Hornell 1936) does not mention specifically that fires were used on board, but a superficial glance through the illustrations would indicate that many of the canoes were large enough to have a fire area.

TRANSPORTATION OF CULTIVARS

It is obvious that cultivars had to be transported from island to island in Micronesia. I interviewed Mr. Donald Anderson of the Lyon Arboretum as he has had considerable experience voyaging from island to island in native craft while working for a supply company some years ago in the central Carolines. Mr. Anderson has also spent some time in Fiji and the Tuamotus and I consider his information valuable as it shows a contrast and comparison. Accord-

ing to Mr. Anderson, the Carolines people transport their cultivars in much the same way as the Fijians and Tuamotuans. For example, in all places the rooted cultivars were wrapped in well rotted coconut husk fiber. Most carefully tended were the breadfruit shoots as they are extremely delicate and tender. Mr. Anderson states that the secret of transporting breadfruit shoots is to let the root sucker gain several years growth so that hard wood is present. At this point the roots are balled in coconut husk fiber and the whole thing is wrapped in dried leaves, different kinds of leaves being used depending on the area. Then a coconut basket is woven around the entire sucker. This is done with each individual plant.

In fact, every cultivar was packaged in such a manner, that is, with a coconut leaf basket woven around it. These people understood the devastation of salt water upon root tips. When a root tip encounters salt water it is killed and another root tip has to form, keeping the plant in a period of suspended growth. If the intent of the voyage was to colonize, this could be quite a setback. The woven basket method must have been quite successful.

In discussing Cyrtosperma, Mr. Anderson says that it was cut in half lengthwise and stacked in the um or earth oven between layers of stones. After the first cooking the Cyrtosperma was still what he called "mane'o" or itchy, referring to the calcium oxalate taro contains, which is irritating to the lining of the throat and mouth unless the taro has been thoroughly cooked. It was grated, mixed into cakes and allowed to ferment. It was then recooked. He says that it tasted like sour poi and looked grayish yellow.

He mentioned more than once, and quite poignantly, the repetition of bailing the canoes. He said that sometimes all he did was scoop water. He also added that the natives always had a hand line out fishing while in their canoes. He said even if they were paddling there would be a hand line out.

A NOTE

Something should be said about Andrew Sharp's (1963) statements on cultivar and animal transportation. He suggests one theory that a canoe full of pigs, dogs and chickens broke loose from somewhere and drifted to another island, washing ashore there and thus inhabiting the island with animals. Dodd (1972:156) puts this to rest by asking the question as to who was to feed these animals as they drifted about in the Pacific Ocean. I also add that there must have been a male and female of each species, or at least gravid females, in order to have a viable population. On a minor point, Sharp (1963:94) further states that "The great majority of useful plants found on the farther Polynesian islands could be grown from seeds occupying little space in transport." However, in tabulating the 27 to 29 cultivars thought to be of Polynesian introduction, only 9, I feel, could have been propagated by seed.

APPENDIX

Nutrients	100 g.	E.P. of ½ med. or 1 small, 250 g.	E.P. of 1 med. or ½ large, 500 g.	E.P. of 2 med. or 1 large, 1000 g.
Calories	128	320	640	1280
Protein, g.	1.4	4	7	14
Calcium. mg.	21	52	105	210
Phosphorus, mg.	52	130	260	520
Iron, mg.	0.8	2.0	4.0	8.0
Vitamin A, I.U.	10	25	50	100
Thiamine, mg.	0.08	0.2	0.4	0.8
Riboflavin, mg.	0.08	0.2	0.4	0.8
Niacin, mg.	1.21	3	6	12
Ascorbic acid, mg.	4.0	10	20	40

Table 1. Nutritive value of various quantities of breadfruit. (Murai 1958:30)

Nutrients	1 key 75 g.	5 keys 375 g.	10 keys 750 g.	20 keys 1500 g.
Calories	53	265	530	1060
Protein, g.	0.28	1.4	2.8	5.6
Calcium, mg.	7.2	36	72	144
Phosphorus, mg.	19.4	97	194	388
Iron, mg.	0.7	3.5	7.0	14
Carotene, mcg.	932	4660	9320	18640
Thiamine, mg.	0.02	0.1	0.2	0.4
Riboflavin, mg.	0.03	0.15	0.3	0.6
Niacin, mg.	0.7	3.5	7	14
Ascorbic acid, mg.	2	10	20	40

Table 2. Nutritive value of the edible portion of various quantities of large pandanus keys. (Murai 1958:78)

APPENDIX (cont'd.)

Nutrients	100 g.	300 g.	500 g.	750 g.	1000 g.
Taro					
Calories	153	459	765	1148	1530
Protein, g.	1	3	5	8	10
Carbohydrate, g.	37	111	185	278	370
Calcium, mg.	26	78	130	195	260
Phosphorus, mg.	51	153	255	382	510
Iron, mg.	1.0	3.0	5.0	7.5	10.0
Thiamine, mg.	0.092	0.28	0.46	0.69	0.92
Riboflavin, mg.	0.030	0.09	0.15	0.22	0.30
Niacin, mg.	0.85	2.6	4.2	6.4	8.5
Cyrtosperma					
Calories	131	393	655	982	1310
Protein, g.	0.9	3	4	7	9
Carbohydrate, g.	31	93	155	232	310
Calcium, mg.	(334)	(1002)	(1670)	(2505)	(3340)
Phosphorus, mg.	56	168	280	420	560
Iron, mg.	1.2	3.6	6.0	9.0	12.0
Thiamine, mg.	0.045	0.14	0.22	0.34	0.45
Riboflavin, mg.	0.074	0.22	0.37	0.56	0.74
Niacin, mg.	0.88	2.6	4.4	6.6	8.8

Table 3. Nutrients from various quantities of two starchy aroids (Murai 1958:99)

Nutrients	Coconut sap					Embryo				
	100 g.	200 g.	300 g.	500 g.	1000 g.	100 g.	200 g.	300 g.	400 g.	500 g.
Water, g.	87.5	175	262	438	875	83.4	167	250	334	417
Calories	48	96	144	240	480	80	160	240	320	400
Protein, g.	0.22	0.4	0.7	1.1	2.2	1.30	2.6	3.9	5.2	6.5
Fat, g.	0.40	0.8	1.2	2.0	4.0	4.08	8.2	12.2	16.3	20.4
Carbohydrate, g.	11.40	22.8	34.2	57.0	114.0	10.28	20.6	30.8	41.1	51.4
Calcium, mg.	0.4	0.8	1	2	4	19.2	38	58	77	96
Phosphorus, mg.	20.0	40.0	60	100	200	66.1	132	198	264	330
Iron, mg.	0.18	0.36	0.54	0.90	1.8	0.69	1.38	2.07	2.76	3.45
Thiamine, mg.	0.016	0.032	0.048	0.08	0.16	0.015	0.030	0.045	0.060	0.075
Riboflavin, mg.	0.006	0.012	0.018	0.03	0.06	0.032	0.064	0.096	0.128	0.160
Niacin, mg.	0.48	0.96	1.44	2.4	4.8	0.86	1.72	2.58	3.44	4.30
Ascorbic acid,mg.	20.6	41	62	103	206	6.0	12	18	24	30

Table 4a. Nutritive values of various quantities of coconut sap and of embryo from sprouted coconut.

(Murai 1958:63)

Nutrients	100 g.	200 g.	300 g.	400 g.	500 g.
Energy	414	828	1242	1656	2070
Protein, g.	4.0	8.0	12.0	16.0	20.0
Fat, g.	40.4	80.8	121.2	161.6	202.0
Carbohydrate, g.	15.4	30.8	46.2	61.6	77.0
Calcium, mg.	14	28	42	56	70
Phosphorus, mg.	101	202	303	404	505
Iron, mg.	2.2	4.4	6.6	8.8	11.0
Thiamine, mg.	.040	.080	.120	.160	.200
Riboflavin, mg.	.014	.028	.042	.056	.070
Niacin, mg.	.613	1.226	1.839	2.452	3.065

Table 4b. Nutrients from various quantities of mature coconuts.
(Murai 1958:55)

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