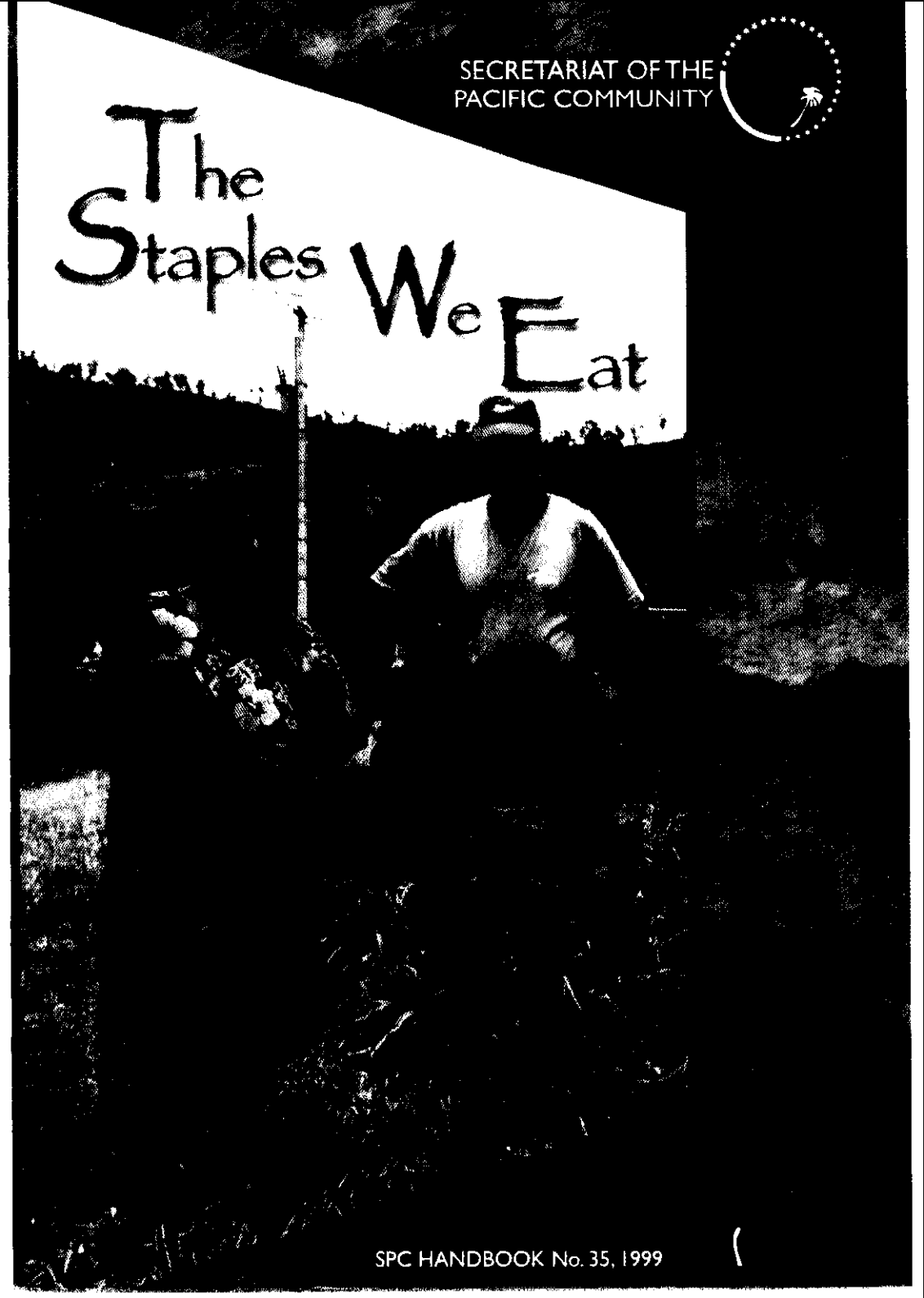
SECRETARIAT OF THE
PACIFIC COMMUNITY

The Staples We Eat



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Pacific Foods

The Staples We Eat

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The Staples We Eat

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TABLE OF CONTENTS

PREFACE

This handbook provides information on Pacific Island staple foods. It is intended for use by nutritionists, community nutrition and health workers, agricultural workers, health educators and others interested in food, nutrition and health. The handbook focuses on both local traditional staple foods and introduced/imported foods that are now a part of the Pacific life.

The nutritional values of traditional and imported staple foods are discussed, as well as their use, cultural significance, health, social and economic benefits in the Pacific. We hope that the information will help readers to understand the diversity and range of major energy food sources in the Pacific and make better choices of staple foods.

This handbook can also be used as a supplement to other food and community nutrition resources previously produced by the South Pacific Commission (SPC). These include the Pacific Foods Leaflets; the first handbook in this series, *The Leaves We Eat*; the Pacific Diet Advisory Leaflets; the University of the South Pacific (USP)/SPC South Pacific Community Nutrition Modules; and other important educational resources on food and nutrition in the Pacific.

Many people have worked on this project or provided valuable information in the initial development of this handbook. In particular, we gratefully acknowledge the contributions of Mr John Bailey, who was SPC Food Composition Co-ordinator from 1989 to 1991, and Ms Mele'ofa Malolo, who compiled the first draft.

This volume is the second in the series 'The Foods We Eat', using information from the Australian Centre for International Agricultural Research (ACIAR). Food analyses were performed by Bradbury and Holloway in 1988 and published as *Chemistry of Tropical Root Crops: Significance for Nutrition and Agriculture in the Pacific*. Analytical data were also collected from the USP and ACIAR Project on Nutrient Composition of Some Pacific Island Food Crops and Wild Foods, a joint effort of the Institute of Applied Sciences (USP), ACIAR and the Australian Government Analytical Laboratories. The information has been documented in the publication *Pacific Island Foods*, an Institute of Applied Science (IAS) Technical Report

written by English, Aalbersberg and Scheelings in 1996, and the joint SPC/Crop and Food Research/INFOODS publication *Pacific Island Food Composition Tables*. Other resources used are listed in the references (Section IX).

Section I of this handbook gives a short historical and cultural account of the origins and importance of Pacific staples. Sections II and III highlight the basic difference between traditional and imported staples as one of a trade-off between conviviality and convenience and the corresponding benefits and risks. Sections IV and V show the reader the basic uses of traditional and imported staple foods in terms of culture and every-day use. Descriptions of 14 staple foods are given in Section VI. Section VII looks at the future use of staples in the Pacific and Section VIII introduces the nutrient data on the 14 staple foods which are shown in a detailed table (Appendix 1) and graphs. Throughout the text helpful hints and recipes are given, supported by drawings and photographs of various Pacific foods and dishes.

This handbook is by no means complete. It is a collection of practical information and knowledge dealing with common Pacific staples. It is not intended to be exhaustive; we hope that you, the reader, will provide input into future editions that will help us to build on the information given here.

I. About Staple Foods

Traditional staple foods

Staple foods are the basis of the Pacific Island diet. They are usually referred to as 'the foods eaten in large quantities to make up the main part of the meal'. In the Pacific, a meal is not a 'meal' unless large amounts of starchy staple foods are eaten, together with other supplementary foods such as meat, fish or shellfish (*kakana dina* or 'real food'—Fiji, *me'kai moe kiki*—Tonga) (Pollock, 1992).

Generally the main traditional staple foods eaten in the Pacific are root crops. These include the edible aroids or taros, yams, sweet potatoes and cassava. Other staples are energy-giving fruits such as breadfruit, banana and plantain, coconuts and pandanus. Sago (edible palms), and a limited amount of rice are also eaten. In the high or volcanic islands of Polynesia, Melanesia and Micronesia, staple foods may be root crops or starchy fruits such as breadfruit or bananas. In atoll countries, they may be coconut, breadfruit or pandanus. Pandanus will be covered in our next handbook, *The Fruits We Eat*.

The origin of traditional staples in the Pacific is still disputed. The fact remains that these foods were probably first brought into the islands by new settlers, early explorers, missionaries and traders. Some staple crops, such as coconut and pandanus, were undoubtedly present before the arrival of the first inhabitants, although new varieties were also brought in by early inhabitants. Large ditches found in Papua New Guinea (PNG) are thought to have been used for staple crop cultivation 6,000 to 9,000 years ago (Waiko, 1993).

Early explorers brought in cultivated crops such as rice, taro, yam and sugar cane. The Spaniards thought they had introduced sweet potatoes into some of the Micronesian Islands in the early 1600s until they discovered the islands of Polynesia and recognised sweet potatoes already growing there! Pacific Islanders give their own versions of the origin of these foods in legends and custom stories. These have been told through generations. Many rituals and ceremonies are often associated with certain foods such as yams and taro.

One story from Vanuatu—The legend of yams—tells that a long time ago, at Linobil, lived an old man called Saldam. He had ten grandchildren. Linobil was on the seacoast near Namaram Bay in Central Pentecost in Vanuatu. At that time there was no cultivated food and no yams. People hunted and picked wild fruits and raw roots in the bush for their food. One day, Saldam ordered his grandchildren to clear away the bush. 'We will clear the bush, but what for?' asked the ten brothers. 'I will tell you later', replied Saldam.

Saldam was so old that he was unable to walk without a walking-stick. One day Saldam walked to the field that had been cleared by his grandchildren. He was followed by a crowd who wanted to see what would happen at the clearing.

He went to the middle of it, lay down, and told his boys: 'Kill me and cut me up. You will give the different parts of my body to the people who are here with me today. Everyone who will receive a piece of my body must bury it in a field as clean as this one. They will keep the ground free of weeds and put sticks of wild cane into the ground, all around the holes in which the pieces are buried. Then you will build all around the field a barrier made of wood. You will close its entry. All the men and the women who live near it will not be allowed to get in'. The boys followed Saldam's instructions. They gave one thigh and leg to the people from Signal (Nokonwanet). The other thigh and leg were given to those from Lesube. Saldam's head and fingers were given to the people living in the South, by the seaside, after Melsisi River, at Alihak. The intestines were given to people from Lemalda, in the mountains. The blood was given to the people living in the south of the island (the country of the 'Sa' language). Many other groups came and Saldam's grandchildren gave to them the wastes that no one else wanted.

Everybody went home and did as Saldam had told them. A few months later shoots came out of the ground and rested on the wild cane. They began to sprout as they twisted around the wild cane sticks in the ground. The first yams of Pentecost had started to grow.

This myth says that the yams came out of a man's body. It explains why different types of yams are found in different places (Goodwillie & Finau, 1990a). And so the staple food stories continue.

Early studies in the late 1940s showed that there were major differences between the eating habits of atoll dwellers, such as the people living in Kiribati, and those living in volcanic islands and PNG. Coconuts, root crops, breadfruit and fish were the main foods eaten in Kiribati, while volcanic-island diets consisted mainly of foods such as yams, taro, sweet potatoes, bananas and sago. Coconuts, in various stages of development, contributed more than 60 per cent of an average atoll diet. In the volcanic islanders' diet, staple foods provided a major proportion of the daily food, with approximately 86 per cent of the energy coming from traditional staple foods. The intake of protein foods such as meat and fish was observed to be quite low. Small amounts of grain and greens were also eaten.

Coconuts and pandanus were highly regarded as traditional staple foods in many parts of Micronesia (Coyne et al., 1984). Traumatic changes began to appear in the early 1950s and even prior to the second world war, when rice, flour, and tinned corned beef began to appear in the daily food of atoll as well as volcanic-island dwellers.

Today in the atolls, coconut and pandanus no longer make up a major part of everyday meals. This is due to the increasing availability and use of imported staple foods such as flour, rice and noodles. However, traditional staple foods are still being used in traditional recipes and eaten on ceremonial occasions and as healthy snacks.

Successful cultivation of staple foods results from knowledge and experience gained over thousands of years. Some of this information is kept within families and is secret. In Polynesia, Micronesia and throughout Melanesia the knowledge and skills of traditional elders were highly valued and farming tips were passed through generations to ensure successful outcome of the harvests. Special skills in growing *Cyrtosperma* taro (*babai*) in Kiribati and other Micronesian islands depended on the traditional knowledge of individual planters. Planting processes and techniques were often accompanied by rituals and magical activities, such as the burial on the planting site of special stones shaped like the crops planted there. In New Caledonia some varieties of yam were grown only for ceremony, not to be eaten. Planting and harvesting times depended on the elders' intricate knowledge of the different phases of the moon, the tides and the times of the year. Quantity, size and quality of traditional root crops were important criteria for success.

Early missionaries and ethnographers noted established sequences of farming activity. Throughout Melanesia, Polynesia and Micronesia, calendars of events in root-crop cultivation were developed. These outlined appropriate times to clear and prepare the land and to plant tubers, and the steps to follow during the planting, weeding and harvesting seasons.

In many parts of the Pacific, an essential feature of traditional subsistence farming of staple crops for family and household use is a fallow or resting period (without a crop on the land). Most of the land available for subsistence agriculture was cleared of its original forest cover many years ago and has since gone through many cycles. Soil fertility is high immediately after the removal of forest, but declines gradually over the years. Another major reason for shifting cultivation and the fallow period is to control the weeds, pests and diseases which tend to build up when a piece of land is cropped too long. Regeneration depends on leaving the land to lie fallow for a number of years.

The number of years the soil is used before being left fallow depends on the original soil-fertility level and on population pressure. The Tongan system of fallow used on 'tax allotments' is described by Thaman (1976) and Schröder (1983). In Tonga, it was traditional to crop the land for three years and then leave it fallow for five to ten years to allow the soil to regenerate its fertility. On Tonga's rich volcanic soils, this provided sustained agri-

cultural production on the standard 8¼ acre bush allotments. Today, with an increase in commercial export production of single crops in Tonga, this sustainable method is rarely utilised.

In most Pacific islands today, there is increased pressure on land because of population growth, development needs such as construction of roads and buildings, and planting of cash crops. As the fallow period grows shorter and shorter, the soil is often not given sufficient time to recover; weed and pest problems often increase. Soil usually recovers its fertility after a fallow period of 10 years or more, but when the fallow is only about 2–3 years, soil fertility problems are common.

Local farmers usually take into consideration the fertility status of their soils when deciding where to plant their staple crops or what other plants to grow. After a long fallow, the cleared plot is usually planted with taro or yam. In the following season, the same soil might be used mainly for sweet potatoes. Poorer soil, or soil which has already grown taros, yams and sweet potatoes, is commonly planted with cassava.

Measurements of average annual yields of staples such as sweet potato are extremely difficult to obtain, because roots may have been harvested at different stages of maturity. The final yield also depends on many factors, including soil fertility, rainfall, water supply, soil drainage, temperature, farmers' practices and family needs and, in some cases, market prices.

Imported staple foods

When Europeans came to the Pacific, they not only brought with them their own foods, but also remained attached to their own food culture. This provided Pacific Islanders with a wider variety of foods from which to choose. Imported foods were cheaper (sometimes free, if donated after natural disasters), easier to prepare, cook and store. Most importantly, many people acquired a taste for imported foods. Thus these have now become part of everyday life and are included in the general Pacific culture.

Common imported staple foods in the Pacific include sugar, rice, cabin biscuits, bread, potatoes, breakfast cereals, noodles, pasta and other products made from flour, such as roti and dumplings. Islanders are so used to the

taste of these foods that many are now being imported or produced locally. Cabin or island biscuit is an example.

The rapid changes in food habits and lifestyles as a result of increased westernisation have led to major changes in the staple foods consumed by Pacific Islanders. Increased contacts with the rest of the world meant that the islanders learned new technologies and began to seek cash incomes. Food rations such as bread, rice, sugar and corned beef were introduced as part of workers' meals. Increased urbanisation also meant that islanders began to depend on store foods—imported foods—to supplement or replace their traditional diets.

Some benefits are associated with the increased consumption of imported foods, but there are also health risks, especially if these foods are used in isolation without other healthy supplements. It is important for Pacific Islanders to understand the nature and composition of imported foods and know how to prepare and use them appropriately in their diets.

The most common grains grown in the Pacific are rice and maize. Although rice was grown in some Pacific Island countries before early European colonisation, it is still considered an imported food because large quantities are imported. More information on rice is contained in Section VI, which deals with the composition of traditional and imported foods.

II. Traditional Staples for Health and Pleasure—Value, Composition and Availability

Cultural and social significance

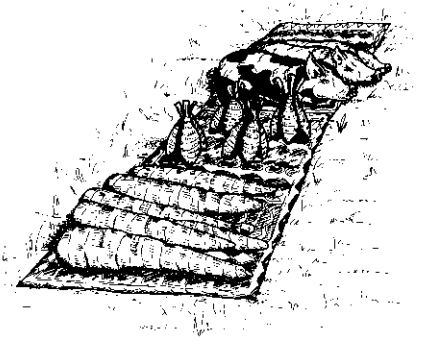
Traditional staple foods play a very important role in the life of Pacific Islanders. Despite early food colonisation and influence of western lifestyles on food habits, traditional staple foods are still highly regarded, not only as a means for sustenance but as the basis for meaningful exchanges of culture.

Staple foods are used in traditional ceremonies between tribes or family groups. Provision and exchange of staples such as yams, taro and giant taro, together with whole carcasses of pigs, chickens, goats and cows, are important in maintaining good relationships and solidarity between groups. In many parts of the Pacific, it is still customary to present the first produce of the harvests (mostly the best yams, taro, cooking bananas or plantain and other foods) to the pastor, head of state, high chiefs or elders of the family, or at a thanksgiving ceremony, as a token of respect and goodwill and for future successful harvests. In some Melanesian societies, the yam is a significant symbol for religious and cultural events throughout the year. In Pohnpei in Micronesia, breadfruit and yams are given to the chiefs. Yams in the Federated States of Micronesia are used not only for consumption, but also for cultural ceremonies, festivals, feasts and tribute (Pollock, 1992).

Tokelau feast 1999 style!

To own large areas or gardens of yams, taro and sweet potatoes is a sign of wealth and power. Respect was accorded to those who worked on the land and who produced plentiful supplies of staple foods, especially status foods such as yams.

Certain types of staple foods are accorded a higher status when it comes to traditional ceremonial feasts. Staple foods such as yams, taro, giant taro (*Alocasia macrorrhiza*), sweet potatoes and sago are some of the acceptable foods that can be served on ceremonial occasions. The social status of a crop varies in different countries. Some, such as cassava, are considered of low status and are only used at home. The amount presented or donated during ceremonial feasts or community gatherings is also important. These gestures, and values placed upon staple foods, are still very much a part of Pacific Island culture today despite environmental disasters, pests and economic threats to their availability.



Economic benefits

Although traditional staple foods continue to be widely eaten in the Pacific, they are also sold for cash to obtain refined foods such as flour and sugar, and non-nutritional items such as fuel (kerosene) and tools. Sometimes traditional crops were traded for imported foods such as rice and flour; this often required extensive travel between island groups and between communities.

With rapid changes from subsistence to commercial agricultural practices and cash cropping, many communities began to produce root crops to boost their export trade rather than for household food security. Taro pro-

duction for the New Zealand, Australian and United States markets today is a case in point.

Pacific Islanders are proud people. They love to promote their culture overseas, particularly their food culture. In addition, Pacific Islanders living overseas appear to be much more patriotic than those living at home. Hence, they crave the taste of island foods, especially traditional staple foods that may not be readily available in shops and supermarkets overseas. Consequently, export of traditional local staple foods from the Pacific to overseas markets has increased rapidly in recent years.

General nutrient composition

Generally, traditional staple foods are high in energy as well as providing some protein, minerals, vitamins and dietary fibre. The nutrient content of a particular staple food can vary greatly. These differences in composition are due largely to environmental factors and the existence of different cultivars or varieties of each staple food.

Root crops are generally low in vitamins and minerals, except for potassium. However, consumption of large quantities makes a substantial contribution to the average daily requirements of some Pacific Island people. Vitamin C is present in raw staples, but is lost during cooking. Certain sweet potato and yam varieties, particularly the orange- and yellow-fleshed-types, contain greater quantities of beta-carotene or pro-vitamin A than the white varieties. Carotene is relatively stable during cooking.

Differences in soil composition between different areas in the Pacific influence the amount of minerals (such as calcium, iron and zinc) present in staple foods. For example, in the East Sepik province of PNG, certain types of yams have lower zinc and iron content than in other areas due to the low iron and zinc content of the soil. This kind of knowledge becomes important in areas where sources of nutrients such as protein and vitamins are limited or where there is widespread malnutrition and a lack of fresh fruits and vegetables.

An outstanding feature of staple foods, in particular root crops, is their contribution to the total diet. Naturally the predominant nutrient is carbohydrate

and this varies with the types and varieties of the different crop species that are available. Some species of taro seem to have higher protein content. For example, some cultivars of *Colocasia* taro have as much as 7 grams of protein per 100 grams and a higher amount of potassium than other taros. *Alocasia* and *Cyrtosperma* taros have greater amounts of calcium. *Xanthosoma* has a higher Vitamin C content. This implies that the diversity of *Colocasia* taro is a factor promoting healthy food choice for those living in areas where other food sources of vitamins and minerals are lacking.

A great deal of information has been collected in the past 50 years on the nutritional values of staple foods in the Pacific, for example by Peters (1957) and later by Bradbury and Holloway (1988). Information has also been collected in the Philippines, Africa and Asia.

A store of energy

Traditional root crops such as taro, sweet potatoes, cassava and yams are held firmly in the soil so that they can withstand the forces of wind, rain and foraging animals. Nutrients and water travel through the very fine roots from the surrounding soil. Because roots grow underground and away from light, root crops depend on their leaves and stems for food or energy supplies.

Through photosynthesis, the leaves and green stems capture the energy from the sun to make organic matter from air, water and soil nutrients. Some of this organic matter is used to satisfy the energy needs of the plant. The rest is stored as carbohydrates or other organic forms in various parts of the plant. The carbohydrates, such as starch and sugars, are found in the roots, which is why these are valuable energy food sources.

Plants can only use their green pigments to produce organic matter during daylight, so the amount of food stored in their roots represents the difference between what they produce by photosynthesis during the day and what they use for respiration during both day and night.

This is why the ordinary potato, which originated at high altitudes in South America, needs long warm days and short cool nights for satisfactory starch accumulation. High night temperature would result in most of the energy stored by the potato during the day being used up for respiration at night. Consequently, only very small potatoes would be produced. The sweet potato, on the other hand, originated in the tropical lowlands of South America and has a very low respiration rate. This enables it to accumulate more organic matter (such as starch and sugars) in its roots, in spite of warm nights. This is why sweet potatoes are bigger than ordinary potatoes.

The energy content of staple foods is influenced by a number of factors: varieties of staples, moisture content, soil types, cooking, extent of processing and preservation methods used, storage methods, and specific nature of that particular staple.

The energy value of each staple depends on the amount of water (moisture content) present after harvest or after processing. The higher the moisture content, the lower the energy value, and vice versa. Fresh root crops have been found to be lower in energy than raw rice. However after cooking, both have approximately the same energy value.

Of the staple root crops, cassava has the highest energy value and yams the lowest. This difference may not be significant when taste and choice between the two crops are considered. Yams are always in high demand because of their texture, taste and status and when available, are often consumed in larger amounts than cassava.

There are also significant differences in energy between the different varieties, especially sweet potatoes grown in different areas of the Pacific. For example, in Tonga and the Solomon Islands, the 'Hawaiian' variety and the *Tongamai* have higher energy values than other local varieties such as the *Melefakahau*. The Hawaiian variety has the highest protein content and the *Halasika* variety the lowest (Schröder, 1983). These names identify place of origin or person who introduced the different varieties.

White bread and cabin biscuits provide a much more concentrated source of energy than yam, taro, sweet potatoes, cassava, breadfruit or banana (plantain). However, in terms of actual intake per person per day, there are considerable variations in the quantities of starchy staples consumed, compared with cereal products. For example, in the atoll country of Kiribati, the approximate quantities of starchy staples available for consumption per day are much lower than in Vanuatu, whereas the amount of cereals available for consumption is almost twice as much.

Health benefits

In the past Islanders used to prepare and eat a variety of root crops and starchy fruits. Cooking a variety of traditional staples in one pot ensured that the family meal provided all or most of the nutrients required, especially those that are of limited content in one or two staple foods. Large crops such as yams and taro were placed at the bottom of the pot and starchy fruits such as bananas, plantains or breadfruit on top. A good, nutritious meal was also provided by cooking several different staples, often accompanied by meat, fish or leafy vegetables, in the earth oven, wrapped in leaves (called *bougna* in New Caledonia).

Chicken Bougna (pot style, New Caledonia). Raw ingredients in the pot ready for cooking; the modern alternative to cooking in banana leaves in an earth oven.

Staple crops such as taro and other roots and starchy fruits also contain complex carbohydrates. These are a more appropriate source of energy, especially for those suffering from chronic degenerative diseases such as diabetes and high blood pressure, than energy obtained from fat sources. Diets high in complex carbohydrates and low in fat, especially saturated fat, have been found to reduce blood fat in those suffering from heart problems. Additionally, high-complex-carbohydrate, low-fat diets tend to release sugars more slowly. This is of particular benefit for people suffering from diabetes.

Taro starch granules are more easily digested than those of other root crops. They are much smaller than those of sweet potatoes. This makes taro an excellent food for infants. This unique property of the taro plant has been recognised by food companies overseas. For example, in the United States, taro starch is being processed into commercial infant formulae. Taro could be particularly useful for infants with eating disorders or allergic to cereals or milk. From a dental health point of view, studies have found that those who eat taro are less likely to develop tooth decay and acute infections of the gums (Pollock, 1992; Wang, 1983). Taro paste (*poi*), eaten fresh or fermented, has been recommended for those suffering from certain allergies.

The fat content of traditional staple foods, with the exception of coconut, is negligible. This makes them a popular food for those wanting to lose weight. However, in the Pacific, traditional staples are often consumed in large amounts—as much as three to four times the average European serving size of approximately 250 grams. This will provide too much energy for an average Islander, especially without any regular daily exercise.

Sweet potatoes contain beta-carotene or pro-vitamin A, which can provide protection against some cancers. The pro-vitamin A pigments, carotenoids, appear to play an important role in preventing or delaying the growth of skin tumours induced by ultra-violet B radiation.

The importance of dietary fibre in the Pacific Island diet cannot be overstated. The fibre content of the traditional diet appears to have been adequate. However, today, with frequent consumption of imported refined foods, such as white flour and sugar, the total daily intake may fall below the recommended daily requirement. Fibre-rich foods help prevent constipation by providing bulk to the diet and allowing a much quicker passage through the gas-

tro-intestinal system. The soluble component of the fibre has also been found to help prevent bowel-related disorders, diverticulitis, irritable bowel syndrome, bowel cancers, stress, diabetes and heart disease. There is therefore a constant need to increase awareness of the beneficial effects of foods high in dietary fibre.

Undesirable effects of some staples

Certain chemicals present in some traditional staple foods, particularly some root crops, can be toxic or may reduce the availability of other nutrients.

Cyanide or, more accurately, cyanogenic glycosides, are natural toxic substances present in cassava. These can be poisonous if they are degraded or broken down to another form called hydrogen cyanide. The actual glycoside that has been found to be present in cassava and cause poisoning in humans is called *linamarin*. The cyanogenic glycoside tends to increase when cassava is grown in poor soils or low moisture conditions. When fresh cassava is prepared, especially if it is grated or crushed, hydrogen cyanide is released. If this is ingested through improper preparation of fresh cassava, the glycoside is rapidly absorbed from the digestive tract and may cause illness and death. Some varieties of cassava are considered sweet if the amount of cyanogenic glycoside is low. They are the common varieties. Most cassava in the Pacific is low in cyanogenic glycosides.

Cassava is usually best left in the soil until required. It does not store well and the enzymes that promote the production of the toxic glycosides are activated by damage such as removal of the tubers from the plant. Fortunately the cyanogenic glycosides are soluble in water and are leached out during preparation when the cassava tuber is cut, peeled, grated and squeezed. By this method, the juice (which can be sun-dried to produce a powder) is separated from the solid particles. These are mixed with coconut cream or meat and baked in the underground oven. Peeled cassava can be soaked in water until it is needed. Discard the water before cooking and, if boiling cassava, always use fresh clean water and discard it after cooking. Cyanide-free cassava varieties are now available in the Philippines and Indonesia, so these problems can be avoided.

The cyanogenic glycosides have been implicated in the progression of endemic cretinism. When cassava is insufficiently soaked or not cooked

enough, the cyanide in the gut is metabolised into thiocyanate. This inhibits the uptake of iodide by the thyroid. High intakes of cassava taken this way have been associated with iodine deficiency and goitre (Ziegler & Filer, 1996).

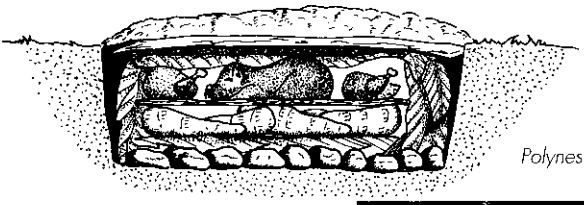
The low protein content (less than 1 g/100 g) of cassava places it in a different nutritional class from other starchy roots. Elsewhere in the world, kwashiorkor (protein malnutrition) is common in communities dependent on cassava. Infants and children are usually fed exclusively on cassava after weaning and kwashiorkor is manifested in infants as a failure to thrive; if they continue to be fed exclusively on cassava, this can lead to stunting (Passmore & Eastwood, 1986).

Fortunately, there is no evidence that kwashiorkor has been or is present in Pacific communities. However, there is an increasing trend for farmers to switch crops from taro to cassava, especially in Fiji and some parts of Vanuatu.

The presence of chemical substances (oxalates) in the skin and leaves of some varieties of taro can cause irritation to the mouth, skin and throat during food preparation, and if raw or half-cooked taro is eaten. The presence of these oxalates can hinder the uptake or use of calcium by the body. Higher concentrations of oxalates were found in taro varieties grown in drought conditions and in poor soil (Bradbury & Holloway, 1988). Ensuring that taro is well cooked during baking, boiling or steaming is very important. Careful peeling of the skin will get rid of some of the oxalates and help minimise the itchiness and irritation to the mouth.

Minimising nutrient loss

Most traditional staples are cooked by boiling, baking, steaming and, to a lesser extent, frying. According to Bradbury and Holloway (1988), dry baking is the best method of cooking traditional staples. This meant that the traditional methods of baking foods in the underground oven (*umu*—Tonga, Samoa and Cook Islands, *lovo*—Fiji, *hangi*—New Zealand Maori) in the past were beneficial. This practice is still popular today in some parts of the Pacific.



Polynesian 'Umu'

Chicken Bougna traditional style—Vanuatu

Baked root crops contain 30–40 per cent more energy per gram than boiled or steamed root crops. There is also little loss of minerals during baking. It has been found that the largest losses of minerals and vitamins occur with boiling. These can be minimised if the cooking water is not thrown away or discarded (except for cassava). Saving cooking water for soups or stews, or cooking staple foods and other vegetables and meat together as in a one-pot meal, ensures retention of important minerals and vitamins in traditional staples. (However there are problems when the high-fat mutton flaps are included in the pot.)

There are also benefits in using modern technology for cooking traditional staple foods. If heat energy (microwave cooking) is used, the food gets cooked in much less time than a conventional oven would normally take to cook the same amount of food. Microwave cooking may also reduce nutrient losses in foods. In the Pacific, cooking traditional staple foods in the microwave may not be an appropriate method, especially if there are large quantities of food to be cooked at once for the family. Other foods, especially meat, snacks, and frozen vegetables, may be more appropriate foods to cook in a microwave. The high cost of electricity and the numbers of members in the family may also be a barrier to this type of cooking.

To retain food value of traditional staples:

- Bake, boil, steam or grill root crops whole in their skin.
- Peel or scrape only a very thin layer of skin to minimise the loss of nutrients just under the skin.
- Bake food in an earth oven rather than boiling.
- If cutting-up the staples, ensure that they are cut into evenly-sized portions. If the pieces are different sizes, the small ones will be done first and will break-up in the water, increasing the loss of nutrients.
- Cover the root crops with water and, once boiling, simmer until cooked. This ensures that the water remains in the pot throughout cooking and enables even cooking of the staples from the top to the bottom of the pot. The simmering method also prevents the water from spilling from the pot onto the stove.
- Put the water on to boil before adding the staple foods. When the water boils again, reduce the heat and cook slowly.

Choosing the best

Choosing the best staple foods for the family is very important. Fresh is best. Sometimes staple foods can take a long time to reach the market, especially if transport is a problem. Below is a guide on what to look for when collecting, harvesting or buying traditional staple foods.

Selection guide for traditional staple foods

Food	Look for
Root crops	No cracks, bruises or holes Not soft, powdery or diseased
Breadfruit	No bruises Hard and light green in colour on the outside White sap appears on skin and runs over it Stalk still in place Firm skin, no discolouration Freshly-picked In some islands, such as Fiji, Samoa, the Cook Islands and some islands of Micronesia, people also use the mature, ripe, soft breadfruit for consumption

Food	Look for
Bananas (plantain)	Ripe and green Large and still in their bunches
Sago	Fresh, green leaves are used as wrappings Fresh smell Good shape Moist feeling Has a high calorie content, but is low in protein and vitamins The nutrient value of sago is increased when other supplementary and nutritious foods are added to it

Choosing the best depends on the purpose: ceremony or eating? (New Caledonia)

Photo: Courtesy of Tour de Côte

III. Imported Staple Foods for Convenience—Nutrient Composition, Benefits and Risks

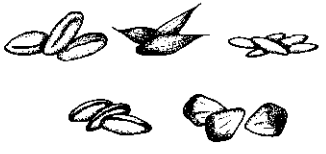
General nutrient composition

Imported staple foods such as white bread, rice, pasta and cabin biscuits generally contain a lot of energy, variable amounts of water, some protein, a little dietary fibre and variable amounts of vitamins and minerals. Cabin biscuits contain the highest amount of energy (approximately 73–77 per cent of energy from carbohydrates). They are also higher in salt and fat than the other staple foods. Pasta and rice are low in fat and high in starch, soluble fibre and energy. The addition of other fats and oils such as butter, margarine and creamed sauces also helps 'fatten-up' imported foods in the Pacific.

Imported staple foods are popular because of their convenience, costs and ease of storage. Unlike traditional staple foods such as yam and sweet potato, they do not need large areas for storage.

Cereals

Cereals are major staple foods in most parts of the world, including the Pacific. Technically the cereal grain is a complete fruit with an ovary that is very thin and dry. Some grains, such as rice, oats and barley, bear seeds that are covered by a husk, while others, such as wheat, rye and maize, do not have to be husked before the milling process.



The endosperm also stores most of the carbohydrates and some protein and this is generally the only part of the grain that is eaten. The parts of the grain (germ and the bran) that contain fibre, oils, B vitamins and most of the protein are normally removed during the processing of flour and normal rice. White or refined flour has been a status symbol for centuries. It is perceived as being purer than wholemeal flour. It was not until evidence of the health benefits of dietary fibre and complex carbohydrates began to emerge that wholemeal grains and their products returned to favour.

Generally the most commonly eaten cereals in the Pacific are wheat and rice. Cereal grains are relatively cheap and can be easily transported and stored.

A cheap source of energy

Introduced staples are now eaten on a more regular basis than traditional staples in most urban communities. Because of the long preparation time, traditional staples are often left for special occasions when more family members and relatives are around to prepare and cook the food. This makes imported staple foods a more popular and convenient alternative for the average Pacific Island working household.

Table 1 gives the energy content of some staple foods. The foods in the shaded area are imported foods.

Table 1: Energy content of some Pacific Island staple foods

Food	Energy kj/100 grams cooked edible portion
Sweet potato (yellow & orange variety)	269
Sweet potato (white variety)	313
Yam	338
Banana (plantain)	455
Cassava	542
Sago	1390
Taro (red variety)	429
Taro (white variety)	407
Breadfruit	293
Flour	1510
Canned corned beef	866
Rice	523
Bread (white)	995
Bread (wholemeal)	923
Cabin biscuits (PNG)	1840
Noodles	603
Breakfast packaged (fruit	1773

Pacific Island biscuits or cabin bread were used in the past as a main source of energy for ships' crews because of their storability during long voyages at sea, hence the old name 'ships' biscuits'. Today these products have been refined and the taste improved by increasing the fat content. This makes the biscuits more palatable and tasty.

Table 2 shows the total fat content of some staple foods in the Pacific. Two varieties of cabin biscuits that are being produced locally in Fiji and PNG are shown. Other islands have their own brands but these have not been analysed. The mean fat content of the processed imported staples (shaded area) is 3.55 g/100 g and is approximately ten times the mean fat content of the local staples (0.3 g/100 g).

Table 2: Total fat content of some staple foods in the Pacific

Food	Total fat content per 100 grams cooked edible portion
Sweet potato (yellow & orange variety)	0.1
Sweet potato (white variety)	0.1
Yam	0.1
Banana (plantain)	0.2
Cassava	0.2
Sago	0.2
Taro (red variety)	0.4
Taro (white variety)	0.6
Breadfruit	0.9
Rice	1.2
Common potatoes	0.2
Rice	0.2
Bread	2.0
Bread (wholemeal)	2.9
Cabin biscuits (PNG)	3.4
Noodles	3.8
Breakfast crackers (Fiji)	8.0

A comprehensive review of dietary studies in the Pacific (Coyne, 1984) found that the amount of energy contributed by carbohydrates in the traditional Pacific Island diet was well over 50 per cent on most larger islands. This appears to be in line with current dietary recommendations. On atolls and in some coastal areas the amount contributed by coconuts (fat) and fish increased significantly. Today, much of the energy contributed to the diet by carbohydrates now comes from imported staple foods such as refined flour,

white bread, rice and sugar. These foods are very much part of the everyday family meal because they are not only cheaper, easier to store and less wasteful (no skin to peel), but also easier and faster to prepare.

Table 3: Percentage energy contributed by starchy roots and cereals to the food supply, by country

Food	Kiribati	Solomon Islands	Vanuatu	PNG	Fiji	New Caledonia
Starchy staples	9	37	16	29	7	6
Cereals	35	31	19	24	39	36

Source: FAO Food Balance Sheet, 1990.

Fibre-rich carbohydrates

Wholemeal products are richer sources of complex carbohydrates and dietary fibre than refined foods. Foods made from wholemeal grains, such as flour, bread and pasta, can provide a broad range of important nutrients such as protein, B vitamins and minerals. These compare favourably with traditional staple foods. However, wholemeal products are not always readily available in the Pacific Islands. Readers should encourage storekeepers to stock more of them.

Fibre-rich carbohydrate foods help relieve constipation. They provide bulk to the diet and decrease the time food takes to be used by the body. Fibre-rich foods also help prevent bowel-related health problems and disorders and other forms of cancers. Table 4 shows the amount of fibre and carbohydrates in some imported or locally-produced staples.

Table 4: Fibre and carbohydrate content of selected staple foods

Food	Fibre (grams/100 grams)	Carbohydrates (grams/100 grams)
Wholemeal bread	5.1	39
Multigrain bread	2.7	41
White bread	11.2	47
Wholemeal flour	3.8	52
White flour	0.8	73
White rice (boiled)	1.6	28
Brown rice (boiled)	5.7	32
Wholemeal pasta (boiled)	8.0	23
White pasta (boiled)		

Beneficial effect of some carbohydrate foods

A large number of common foods, including many of the imported starchy staple foods, have been tested for their effect on blood sugar levels in the human body. Some types of carbohydrate (CHO) are digested at a faster rate, others more slowly. Individuals have varying capacities to metabolise CHO after a meal. People with diabetes, for instance, have an impaired capacity to clear glucose from the blood—a process which is under the control of the hormone, insulin. Therefore for people with diabetes it is important to eat foods that liberate glucose slowly during digestion.

The 'Glycaemic Index' (GI) is a way of describing a food's capacity to liberate glucose. The GI of a carbohydrate food can be ranked according to how fast it increases blood-glucose levels. A high value indicates that the carbohydrates will break down fast, thus releasing sugar into the blood very quickly, and a low value indicates that the sugar will be released slowly into the blood stream. Foods with low GI, below 55, are said to be beneficial for diabetics. Yams, sweet potatoes, taro and rolled oats (porridge) are some foods with a low GI. Table 5 shows some traditional and imported staple foods that have low GI values.

Table 5: Some traditional and imported foods with low Glycaemic Index values

Low GI values (below 55)	Foods
54	
47	
	Pasta
32	Egg fettuccine
39	Ravioli
41	Spaghetti, white, boiled for 15 minutes
35	Vermicelli
	Yam
	Sweet potatoes
	Potatoes, boiled
	Taro

Health risks

Over-nutrition is one of the major dietary factors associated with chronic degenerative disease or non-communicable diseases in the Pacific. Increased energy intake, together with a decrease in physical activity and exercise, contributes to an increase in overweight and obesity. Obesity is one of the major risk factors for diabetes, hypertension, gout, dental caries, gall bladder problems, heart diseases and other health problems.

Traditional staples can be eaten in large quantities without fear of gaining weight. If similar quantities of imported staples are eaten, weight-gain will occur for most individuals.

Traditional staple foods, especially root crops, breadfruit and bananas, are generally high in complex carbohydrates as well as dietary fibre. They tend to be bulky by weight and volume, but are generally lower in energy than refined processed foods such as bread, cabin biscuits, breakfast crackers, cakes and pastries.

Many people in the Pacific consider cabin biscuits to be a local staple food since they are processed locally. However, most of the ingredients required for manufacturing biscuits (flour, fats and oil) are imported. Most of the fats used in biscuit manufacture are saturated fats. If these are consumed in large amounts over a long period, they may contribute to major health problems such as heart disease and high blood pressure.

Dependence on imported foods means a less secure source of food and essential nutrients. Processing of these foods means that a lot of the goodness has been removed. The addition of vitamins and minerals, such as the B group of vitamins and calcium to flour, may not have the same effect in the body as eating traditional foods high in the same nutrients. In addition, there are always risks associated with food-handling and processing techniques due to lack of food laws in most Pacific countries. These risks tend to be high also in areas of the Pacific where food technology expertise is lacking.

Below is a guide on what to look for when buying imported staple foods.

Selection guide for imported staple foods

Food	Look for
Rice	Good smell Clean and dry No weevils Brown rice (has more nutritional value than white rice)
Flour	Good smell Fine, dry grains Dry powder No weevils No lumps Wholemeal flour (more nutritious than white flour, but does not keep well)
Bread	Wholemeal/brown and white Freshly baked Clean Soft inside No damage from rodents or insects Wholemeal bread is more nutritious than white bread

Preparing food on the coral in the Marshall Islands.

The staple foods we eat

Common name	Scientific name (common variety)	Local names	Description	Preparation method
1. Yam	*Dioscorea alata*	Dagu – Guam Fua ufi – Niue Iam – Marshalls/Kiribati Ufi – Tonga Ui – Cooks Umara – Tahiti Uufi or umala – A.Samoa/Samoa Uvi – Fiji	Edible roots have many shapes and may be white, off-white, yellow or purple inside.	Baked, roasted, boiled, salad, soup, stuffed, curried, fritter.
2. Taro (white)	*Colocasia esculenta*	Dalo – Fiji Laraj – Marshalls Suni – Guam Talo – Niue/Samoa/CNMI Talo tea – Tonga Taoraro – Kiribati Taro – Cook Islands	Edible roots about 12 inches or 30 centimetres long for the big varieties. The colours inside after peeling may be white, yellow, off-white/red, off-white/purple.	Boiled, baked, fried, chips, salad, soup, pudding, stew.
3. Taro (red)		Dalo ni tana – Fiji Talo kula – Tonga Talo maganonu – Niue Taro – Tahiti		
4. Sweet potato (white)	*Ipomoea batatas*	Fua simala – Niue Kamuti – Guam Kumala vula – Fiji Kumara – Kiribati/Cook Islands Pateta suamalie – A.Samoa/Samoa Pitetotonal – Marshalls Tongousai/Palu – Tonga Umara putete – Tahiti	Roots may have light brown to purple skin on the outside and when peeled inside may be white, pink, orange, yellow, or purple.	Boiled, baked, roasted, pudding, chips, salad, stuffed, soup, buns.
5. Sweet potato (yellow)		Kumala dromodromo – Fiji Kumala kalali – Tonga Kumala lesi – Tonga Kumara – Kiribati/Cook Islands Umara – Tahiti		

The staple foods we eat

Common name	Scientific name (common variety)	Local names	Description	Preparation method
6. Cassava	*Manihot esculenta*	Makmak manioka – Samoa Manioke – Tonga Maniota – Niue, Cook Islands & Tahiti Mendeoka – Guam Tabioka – Kiribati Tavioka – Fiji	Edible brown roots, may be white or yellow inside.	Boiled, baked, chips, mashed, porridge, fritters, pudding, salad.
7. Breadfruit	*Artocarpus* cultivars	Fua mei – Niue Kuru – Cook Islands Lemona – Guam Mei – Tonga Motiniwae – Kiribati Ulu – A. Samoa/Samoa Uru – Tahiti Uto – Fiji	Fruits differ in shape, size and time of ripening. They are green in colour when mature and yellow when ripe.	Boiled, steamed, baked, salad, stuffed, stew, fritters, pastry, buns, pudding, bread, grilled.
8. Banana (plantain)	*Musa normalis*	Ag'o – Guam Banana – Kiribati Fai – A. Samoa/Samoa Futi mandi – Niue Maia – Tahiti Meika – Cook Islands Siaine – Tonga Vudi – Fiji	Fruit take 4–6 months to mature. They are green on the outside when mature and yellow/red and soft when ripe.	Baked, boiled, roasted, grilled, pudding, chips.
9. Sago (flour)	*Metroxylon* spp.	Saga falawa – Fiji		
10. Bread (white)		Falaoa – Samoa Fareaa – Tahiti Kariki – Kiribati Madrai vulavula – Fiji Usa – Tonga Varaoa – Cook Islands		Sandwich, roll.
11. Bread (wholemeal)		Falaoa enaena – Samoa Fareaa euari – Tahiti Mo'uta – Tonga Madrai sila – Fiji Varaoa – Cook Islands		

The staple foods we eat

Common name	Scientific name (common variety)	Local names	Description	Preparation method
12. Cabin biscuit (bread/crackers)		Bisikete – Fiji Bwereena – Kiribati Ma palupalu – Tonga Masi – Samoa Varaoa pakapaka – Cook Islands		Snack
13. Flour		Burawa – Kiribati Falaoa mata – A. Samoa/Samoa Falaoa mata – Niue Falawa – Fiji Faraoa ota – Tahiti Mahoaa – Tonga Varaoa mata – Cook Islands		Pastry, cakes, puddings, batter.
14. Rice	*Oryza sativa*	Alaisa – A. Samoa/Samoa Alaisi – Niue Laisa – Tonga Raisi – Fiji Raiti – Kiribati, Cook Islands, Tahiti		Fried rice, salad pudding, stew, curry, boiled, sushi.
15. Noodles		Iaia – Kiribati Niutolo – Tonga Nutolo – Niue Saimini – A. Samoa/Samoa		Soup, chop suey, chow mein.
16. Potato	*Solanum tuberosum*	Buteta – Kiribati Pateta – Fiji, Niue, A. Samoa, Samoa, Tonga Pitete – Cook Islands Umara – Tahiti		Boiled, roasted, baked, stuffed, salad, mashed, scalloped, steamed.

IV. Use of Traditional Staple Foods

Feasts and ceremonial presentations

Traditional staple foods are a major feature of feasts and important occasions. In many parts of Polynesia, staple foods form the basis of a meal or ceremonial events and are combined with other foods such as fish, pork, poultry, cooked vegetables, salads and sliced fruits. In a traditional Tongan feast, huge community plates are prepared from coconut leaves and then laid out ready to be filled with food. Staple foods such as yams, taro and giant taro are baked whole, peeled and laid out on these plates in two or three rows. Supplementary foods such as green leafy vegetables, fresh or cooked salads, roast pigs, chickens, beef and fish are then laid on top. In most parts of Melanesia, local staples are often cooked in ground ovens (*mumu*—PNG), and then shared amongst groups of people or at large gatherings.

Traditional desserts such as puddings made from taro, banana, yam, cassava and breadfruit are gradually being replaced by introduced dishes such as trifle, jelly, sponge cakes and pies. The traditional desserts provide a wide array of colours and flavours, are delicious to eat and high in calories, but should be eaten in moderation. Recently-introduced staple foods, made from flour products, noodles and pasta, are also being used as side dishes and desserts.

Polynesian 'Umu' – hot stones, food wrapped in banana leaves (note that some foods are wrapped in aluminium foil) and covered with more leaves.

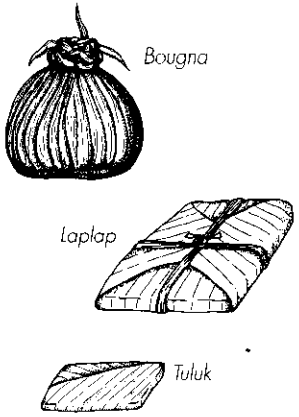
Pacific delights

Cassava and taro pudding is a delicious snack that can also be served with the main meal. It is prepared and served in a variety of ways. Raw cassava and taro is peeled, washed and grated. The juice is squeezed and removed from the solid part of the grated cassava. The grated cassava and taro is then boiled or baked in the underground oven (*umu* or *lovo*). When cooked it is pounded into a starchy mass to which coconut cream is added.

In a similar recipe, the cassava is grated, then squeezed to remove the juice. Meat, sometimes with coconut cream, is placed in the centre of the grated cassava, which is then moulded to cover it. The preparation is wrapped in softened banana leaves and baked in the underground oven. When cooked this meal or pudding can be cut into portions and served. In Vanuatu this recipe is made into individual-sized portions which are called *tuluk*.

Cooked cassava can be mashed and milk added to it before serving.

Cassava cakes are good snacks for children. To produce this snack the cassava is boiled, mashed and mixed with protein foods such as fish or meat. Chopped onions, if desired, are added and the mixture is then formed into balls and fried.



Tuluk (Vanuatu)

Peeled raw taro can be grated, mixed with coconut cream, wrapped in a softened banana leaf and then baked in a moderately hot oven or ground oven for an hour. This makes a delightful snack for young children. Another very popular dish is cooked taro, mashed, beaten and fermented and then baked. This is often made in Kiribati. Taro can also be peeled, sliced and baked with pawpaw and coconut cream and served as a snack or part of a main meal.

One way of using leftover meat or fish is to make a yam pudding. Mash the cooked yam with milk, water or coconut cream, use it to cover a filling of left-over fish, meat or vegetables and bake it in a moderate oven or in a ground oven. This makes a healthy, delicious meal for the family.

Sweet-potato salads provide colour to any meal. Boil the sweet potatoes with their skin, peel and cool them, before cutting into even-sized pieces for the salad. Add low-fat mayonnaise or a coconut sauce before serving. Sweet potatoes can also be used to make scones or bread.

Breadfruit is also an excellent snack for children. It can be processed into chips. The raw breadfruit are peeled, cut into slices and then lightly fried in oil. Breadfruit fritters and buns can be made using cooked breadfruit. In the Caribbean, breadfruit are frozen, dehydrated, canned, or made into flour. In some Pacific Islands, the mature breadfruit is preserved by fermenting it in pits, drying and freezing if a freezer is available in the home. Baked or boiled breadfruit can be stored in a freezer for as long as six months.

A useful agent

Cassava starch or flour is another example of an energy food. It is made by squeezing the grated cassava to extract the liquid. This is then dried in the sun to be converted into powdered form. The starch can be used as a thickening agent in gravies, soups and desserts of cooked and pureed fruits.

Sago starch is also used as a thickening agent in traditional puddings. It is mixed with cooked fruit (banana or pawpaw) and coconut cream, then wrapped in banana leaves and steamed or baked for an hour. The pudding can be eaten as a dessert or served as part of the main meal.

Fresh staple root crops can be chopped and added to stews and other meat dishes to increase the quantity of the dish and improve its nutritional value, as well as being a thickening agent.

Washing out the sago starch, Orokolo Province, Papua New Guinea.

Photo: Courtesy of May, R.J. (1984)

Commercial food production

Traditionally Pacific Island farmers use their land to grow staple foods for the family, community and visitors to their islands. Subsistence agriculture was the traditional means of providing food, whilst cash cropping was mainly confined to copra, coffee and cocoa. Increased migration of people from rural to urban areas caused an increase of the population in the cities, thus causing lifestyle changes. At the same time, there came a need for increased cash income to purchase other important non-food items and household goods. The sale of traditional food crops can be more profitable than growing them just for home consumption.

The demand for traditional crops from Pacific Islanders living overseas also provides an extra incentive for small farmers to produce more traditional crops for the export market and less for family meals. The extra income is often spent on buying introduced staple foods such as flour, rice, bread and sugar to supplement the family diet.

Suva markets, Fiji.

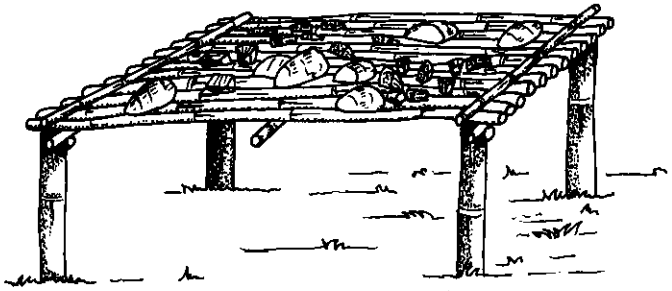
Food preservation and storage

The best way of preserving root crops is to leave them in the ground until needed. For example, sweet potatoes are best left on the plant until required. Once harvested they must be handled with care to prevent any cuts or bruises. Taro keeps well for long periods in the soil but can also be stored in pits with coconut fibre or in a cool dark place for several weeks or for 2–3 months. Yams have a low respiration rate and once harvested can be stored in a cool, dark, well-ventilated room or in yam storage huts for up to 3–6 months.

In the past, food processing and preservation in the Pacific were usually carried out during times of food surplus. This occurred when there was a plentiful harvest, or after natural disasters when a lot of food crops had been damaged and needed to be harvested quickly. Food shortages often occur some weeks after natural disasters such as hurricanes, floods or cyclones. The advantage of staple root crops such as sweet potatoes and cassava is that they can be left in the ground until they are needed, whereas store foods tend to spoil after floods and cyclones, especially when there are power failures.

Excess foods which cannot be kept after cyclones can be preserved by drying, fermenting or, in some cases, freezing (if power supplies are available). Traditional preservation methods were very important in the old days before introduced foods were brought into the Pacific. Islanders felt secure because they had preserved their own food supply for times of need.

Drying was (and still is) a very common method of food preservation in the Pacific. Root crops, breadfruit and other foods are dried to remove excess water. This also minimises the growth of moulds and germs. A very common method is to peel and slice the staple foods and then lay them out on a clean rack (usually made of split bamboo or wire netting). The rack is usually built about one metre high to prevent animals reaching the food. The rack is either placed in the sun to dry or over a fire. The fire should be low enough to heat the food slowly and absorb the moisture, so that the food dries without spoiling. Special food dryers can be made from wood or bamboo and then covered with clear plastic. In the old days, copra dryers were also used for drying food.



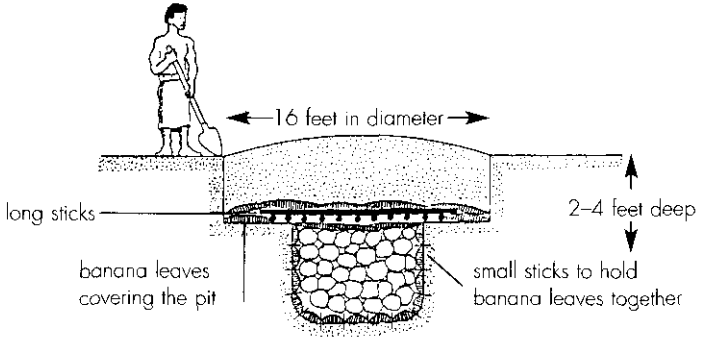
Dried foods, especially staple root crops, contain higher proportions of carbohydrate, protein and minerals than their fresh counterparts. The B vitamins (thiamin and riboflavin) are partially destroyed by drying.

In order to maintain the shelf life of dried foods, they must be kept in airtight containers such as tins, bottles or plastic buckets with lids. In the old days foods were wrapped in banana or breadfruit leaves and then placed in coconut baskets and hung above the cooking area or stored in a rack near it. Dried foods need to be soaked in water for several hours before cooking.

Fermentation of staple foods such as root crops and breadfruit is an old food-preservation process that was first used in the Pacific at least two thousand years ago. Information on traditional fermentation techniques was collected from various island groups through the FAO Root Crops Project (Parkinson, 1984).

Fermentation helps to preserve the food and also improves the flavour of other dishes (fermented foods are used to make dressings and accompaniments for meat and fish). The staples most commonly fermented were root crops, breadfruit and plantain. Generally two methods were used: surface and ground fermentation. Surface fermentation involves tying a basket or sack of peeled staple foods onto a reef in the sea or placing it in a running stream for 4–5 days until soft. The food is then removed, pounded and flavoured with grated coconut, coconut cream and sugar before being cooked. Fermented cassava prepared in this way is called *bila* in Fiji.

The underground fermentation process involves large quantities of staple foods. A shallow pit (about 19 inches (0.5 metres) deep) is dug and then lined with dried banana leaves arranged on the sides and the base of the pit. The staple foods are then peeled and placed in the pit. The dried leaves are folded over the top and more leaves are then put on top for extra cover. Heavy logs and stones are then laid on top to hold the leaves firmly in place. Normally the food is left for a month and can then be used if needed. It can also be left until there is a shortage of food in the community. The leaves on top of the pit must be changed regularly.

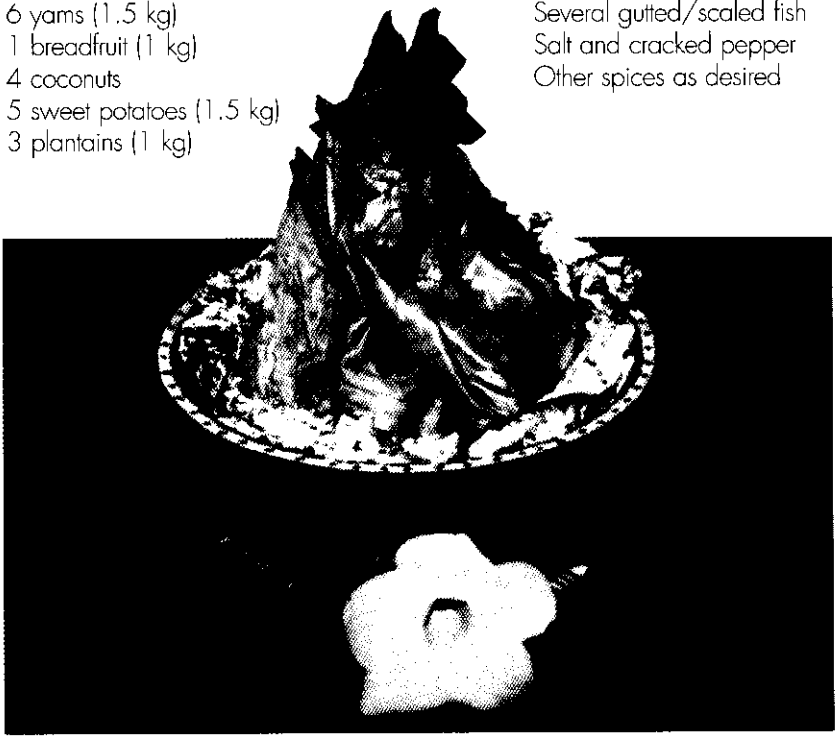


When the fermented food is needed, it is normally pounded until smooth and then mixed with coconut cream and sugar, wrapped in banana leaves and boiled or baked in the earth oven.

Fish Bougna

Ingredients:

2 taros (1.5 kg)
6 yams (1.5 kg)
1 breadfruit (1 kg)
4 coconuts
5 sweet potatoes (1.5 kg)
3 plantains (1 kg)
4 spring onions
Several gutted/scaled fish
Salt and cracked pepper
Other spices as desired



Method:

1. Slice all the root crops and vegetables. 2. Arrange in a circle in the middle of a banana leaf that has been softened in a fire and curled into a bowl-shape. 3. Place fish on top of the root crops and vegetables. 4. Prepare coconut cream from coconuts and pour over ingredients. 5. Season. 6. Carefully close banana leaves and tie up with vines or string. 7. Cook for 2 hours in a traditional or modern oven. 8. Serve as pictured.

Serves 8–10

V. Use of Imported Staple Foods

Relief feeding and food aid

Like traditional foods, grains are good sources of carbohydrates as well as dietary fibre. Unlike traditional staple foods, grains are easy to transport and store for long periods of time with minimal loss of energy values. This is why they are useful for relief-feeding programmes. Although the aim of these programmes is to provide food in the short term, islanders tend to depend on them as regular substitutes for their traditional staple foods. Consequently these introduced foods have now become part of the Pacific diet.

Recently countries such as Australia and New Zealand have reviewed food aid in Asia and the Pacific and have recognised the importance of providing traditional, preferably healthy, locally-grown foods in times of food shortage. Strategies have been put in place to provide culturally appropriate relief. This would certainly help maintain traditional food-supply systems, food habits and culture, and avoid continuing dependency on imported foods.

Maintaining the Pacific flavour

A good way of mixing traditional and introduced food to improve the quality of the meal is to mix flour made from taro, cassava, yam or breadfruit with imported flour. This makes healthy delicious snacks and side dishes. Substitute flour made from root crops for refined flour when using recipes that would normally use plain white flour. This adds variety and extra goodness and at the same time maintains a Pacific flavour. Introduced food such as rice, bread and noodles can also be used together with other staple foods to make up a healthy meal.

Taro cake

Incomplete substitutes for traditional staple foods

In some Pacific Islands, it has now become a practice for many people to consume a diet totally based on imported, refined foods without the addition of local foods such as fresh fruits and vegetables. Essential vitamins and minerals are often missing. For example, bread and tea are a common breakfast for young children in many parts of the Pacific, particularly in urban areas. Rice and cabin biscuits are also given when these are available in the shops. As communication and transportation have improved, imported foods have gradually taken over in popularity and so become more commonly used than traditional foods such as mashed root crops, fresh (green) coconut meat, toddy, green leaves and fruit juices.

Food production and processing

Rice is grown in a few parts of the Pacific, mainly for the local markets. The amount produced is not often enough, so a large quantity is still imported from Australia and the United States. Approximately 90 per cent of the rice grown in Australia is exported overseas. Two main rice varieties are produced for export: short-grain and long-grain. The most commonly eaten is polished white rice in which the bran or outer covering of the grain has been removed by polishing. This method removes part of the dietary fibre, vitamins and minerals. Brown and parboiled rice are the most nutritious as they are good sources of dietary fibre, vitamins and minerals. Parboiled rice is partially cooked with the bran layer still present, then dried and the bran removed.

Wheat flour is mainly imported by the islands from Australia and New Zealand. When used for baking it produces the best bread, cakes, buns, doughnuts, baguettes (French bread) and island biscuits. Bread used to be baked in huge ground ovens more than 20 years ago. Today more modern equipment is being used for the purpose. Only a limited amount of wholemeal flour is used for baking bread, because the demand is not high. Some local cake-shops make creamed sponge-cakes, sweet pies and doughnuts. In many parts of Polynesia small cake stalls sell home-made doughnuts made from flour, sugar, water and yeast.

VI. Composition of Some Staple Foods in the Pacific

Fourteen commonly eaten staple foods are described in this section. Each is illustrated by coloured photographs. The nutrient composition of these foods is presented in tabular form in Appendix 1 and graphically in Figures 1–14.

Food composition data used were obtained from *The Pacific Islands Food Composition Tables* (Dignan et al., 1994), with the exception of one brand of cabin biscuits. This was analysed in Fiji at the University of the South Pacific Laboratory, with results published in *Pacific Islands Foods: description and nutrient composition of 78 local foods* (English et al., 1996). Nutrient data on rice were obtained from the Australian food composition tables (English & Lewis, 1991). Values used for sago flour, mature coconut and imported flour are uncooked values. In Figures 12 and 13, the vitamin content of noodles has not been analysed.

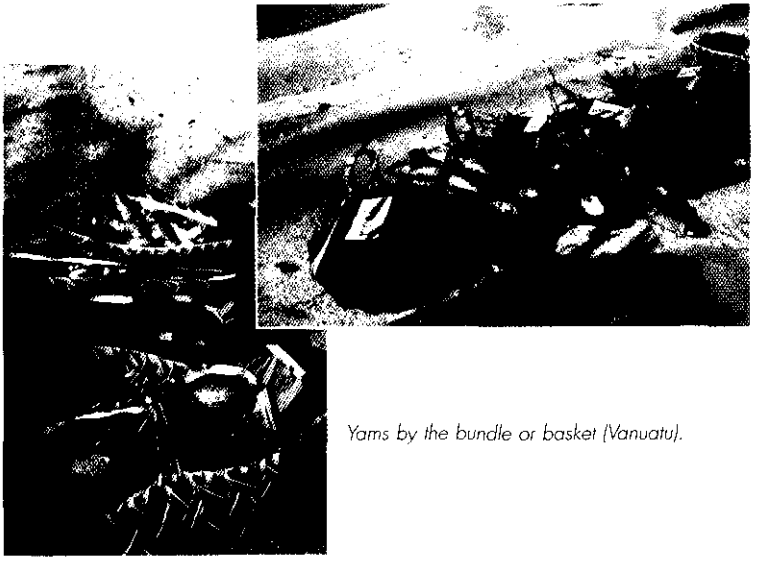
1. Traditional staple foods

Yam: Dioscorea alata *and other species*

One of the most highly regarded staple foods in many Pacific islands is yam. There are over 60 varieties of yams in the Pacific (SPC, 1990b). Yams are highly regarded for their size, texture, delicious flavour and cultural values. Generally in islands in Melanesia and Polynesia, no ceremonial occasion is complete without the presentation of yams, cooked or raw. Yams grown in the Pacific Islands are of three main varieties: *Dioscorea alata*—the greater yam, *Dioscorea esculenta*—the sweet yam and *Dioscorea nummularia*—the wild yam, which can be used as a relief food.

Most are grown extensively in many parts of the Pacific, with *Dioscorea nummularia* mainly grown in Tonga, Fiji and Samoa. Yams need good-quality, well-drained soil. A small yam tuber or the top or a slice of a larger yam root is used as planting material. In New Caledonia, yam is traditionally a man's crop and only planted by men. When growing, yam vines are often trailed onto poles or other supports. This technique is said to improve the yield. Traditional methods of cultivation often result in high yields.

Yams can be harvested approximately 9–12 months after planting. The main harvest period is from May to August in PNG, June to December in New Caledonia and many other parts of the South Pacific, and November to March in Micronesia. Storage huts were traditionally built to store yams. Only a few of these huts are found today.



Yams by the bundle or basket (Vanuatu).

Yams provide a good source of energy, and adequate amounts of thiamin (Vitamin B1), Vitamin C and dietary fibre. When they are in season (and during the festive season yams are a regular part of the Pacific Island meal), they can provide a fair amount of iron and niacin.

The best method of cooking yams is to roast them over hot coals or to bake them whole in an underground earth oven. Boiling yams will reduce the vitamin content. Cooked with other meat and vegetables or served separately as part of the main meal, yams will provide an excellent energy source for family meals.

For more information on preparation, cooking and recipes for yams, please refer to South Pacific Foods Leaflet no. 14 (SPC, 1990b).

Taro: Colocasia esculenta *and other species*

Taro has a special place in the heart of Pacific Islanders because, apart from its skin, every part of the taro plant can be eaten. The major goodness of this versatile crop is in the roots. Taro may be divided into four species: *Colocasia esculenta* (true taro), *Xanthosoma* (palagi taro), *Alocasia* (giant taro), and *Cyrtosperma* (giant swamp taro), which is mostly grown in atolls and high-island areas in Micronesia.

The *Colocasia* variety is known as the 'true' taro. It is said to have originated in India and spread into Indonesia (Barrau, 1965) and then into the Pacific, with the PNG Highlands being the first area to grow taro.

Like all taros, *Colocasia* belongs to the Araceae family. It is different from the other species because of its leaf structure and the shape of the tuber. It can grow to a height of about a metre and its arrow-shaped leaves are eaten in many parts of the Pacific. The average weight of the mature tuber is about 1–2 kilograms.

Colocasia taro can be grown in a range of soil types and requires adequate rainfall. In parts of Melanesia it is sometimes grown in irrigated gardens. The time needed for each crop to reach maturity varies with the climate and temperature. The upper section of the corm or tuber is used as planting material for the next crop. The larger the upper portion, the better the quality of the taro produced. The average growing time is approximately 9–14 months. Storing *Colocasia* taro can be a problem in the Pacific, as it does not last very long. It can keep for about 1–2 weeks with the tops intact and only about 5 days without the tops. Taro is a woman's crop and mainly planted

by women in New Caledonia. Traditionally, the best way to preserve taro is to keep the tubers in the ground until they are ready to be used, or in a box covered with moist sawdust.

The taro root is a very good source of energy. The carbohydrate content ranges from 13 to 29 per cent, with protein content 1–2 per cent. The taro granules are said to be much more digestible than those of other root crops; hence it is an excellent food for young infants, particularly those who may be allergic to certain cereals.

The best way to cook taro is to bake it in its skin. It can also be roasted on hot stones, or boiled. Cooking with the skin will certainly keep the vitamins contained in the skin from being lost.

Cyrtosperma taro is a taller plant and has larger leaves. It is known as giant swamp taro or *babai*. This species probably originated in South East Asia and then spread to Micronesia. It is mostly grown in pits or swamps in Chuuk, Kiribati, Tuvalu and Fiji.

The shoots coming from the old root or the top of a mature corm or root are normally used as planting material. The shoots are placed in a pit and covered with compost and soil. The compost may consist of chopped leaves, pandanus and coconut palm fronds. As these materials rot, more are added to maintain the compost. *Cyrtosperma* taros are normally left in the pits for a number of years. They are mostly harvested for ceremonial occasions. Younger corms may be harvested early, but certain varieties can be left in the pit for 10–15 years. In Fiji, *Cyrtosperma* was used as a main food in times of floods and hurricanes.

Alocasia or giant taro is a much more hardy plant and originated from South East Asia. Suckers are used as planting material. Tubers can also be used. *Alocasia* can be grown all the year round but is often grown together with yam. This species of taro has a high oxalate content and must be prepared and thoroughly cooked to avoid causing itchiness. It is mostly grown and eaten in Polynesia.

Xanthosoma, an easily grown plant which originated in tropical America, was brought to the Pacific about one hundred years ago. The roots of this

variety of taro are smaller than those of *Colocasia* and *Cyrtosperma*. They are either white or purplish-pink in colour, both raw and cooked, and keep longer than *Colocasia*.

***Sweet potatoes:* Ipomoea batatas**

The sweet potato is a staple food that is not only a store of goodness, but can be easily grown, and matures quickly. This root crop is said to have originated in Mexico and South America.

The roots come in a variety of colours: white, orange, purple and yellow. The orange-fleshed variety is of special importance to consumers because of its higher carotene content. Sweet potatoes are normally grown in the drier months. Stem cuttings are generally used for planting, although the roots can also be used. They can be harvested 3–7 months after planting, when the leaves turn yellow. There are hundreds of varieties grown in the Pacific and many of these can be produced locally.

In Papua New Guinea the sweet potato is an important food, particularly for the Highland regions. It is well suited to less fertile soils and can provide a steady supply of food in times of food shortage. This is because it has a relatively short growing period. It can be rotated with other crops or grown continuously. There are slow-maturing varieties and these can be grown in combination with the faster-maturing types to give a steady supply of food throughout the year.

Nuku'alofa markets, Tonga.

Sweet potatoes can keep for a long time if stored in a cool, dark, airy place, provided they are not damaged by insects or during harvesting. According to Barrau (1973), sweet potatoes were normally left to dry out in the sun before they were stored. They can also be stored in cold ashes.

Sweet-potato roots are a very good source of energy, as well as of vitamin A for some varieties. In areas where there is a limited supply of meat and fish, sweet potatoes can also provide a good source of protein. They are particularly important as a food for young children because of their vitamin A content. Sweet potatoes mashed with the young leaf tips and a teaspoon of coconut cream for flavour make an excellent weaning and/or supplementary food for young children.

Sago

Sago is an important energy food in Papua New Guinea, where the palms grow wild over large areas of the lowlands. In places where there is very little fertile land to grow other subsistence crops, sago can provide the major bulk of the energy source of the diet.

There are generally four species found in the Pacific (Massal & Barrau, 1956). These are: *Metroxylon rumphii* and *Metroxylon oxybracteatum*, mostly grown in PNG, and *Metroxylon bougainvillense* and *Metroxylon salomonense* grown in the Solomons. They grow as part of the main vegetation of the swampy forests that spread over extensive areas of the lowlands. The palm is said to be native to Indonesia and to have spread into PNG from Malaysia. *Metroxylon rumphii* is thought to have been introduced by the Germans before the first World War.

Palm frond used for sago production (see photo page 34).

The palm can grow to a height of about 50 feet (16 metres) with a trunk diameter of about 30 inches (1 metre). Each tree flowers only once during its lifetime. It can sometimes take about 15 years for the palm to flower and to bear fruit.

When the tree is ready to flower, the trunk of the palm is cut down to extract the starch in which it is very rich. The bark is partially removed and the inside is pounded to extract the starch. This is washed, drained, partly dried and wrapped into cylindrical or conical bundles using the green *Metroxylon* leaves. The starch can be preserved by sprinkling with water occasionally, or it can be stored in a jar and covered with water until required.

The sago starch can be mixed into a paste with coconuts, legumes (such as beans or peas), spices and meat or fish, and then rolled in green leaves or packed in a half-coconut shell or a section of bamboo and cooked. The starch can also be used to make a pudding or porridge that can be served with green leaves or meat.

Normally the palm tree dies after bearing fruit, but it can give out a number of new suckers (shoots) that will grow into new trees.

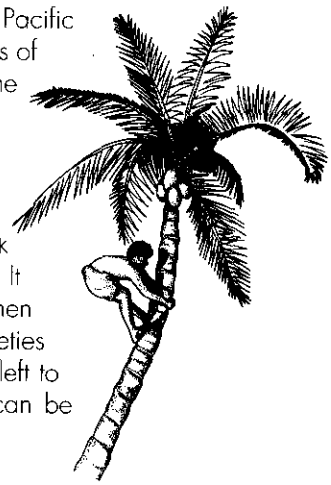
Sago bundles hanging to dry.

Adapted from May, R.J. (1984)

Generally sago contains mainly water and starch—approximately 83 per cent starch and 13 per cent water (Dignan et al., 1994). It has a very low protein content, almost no fat, and contains traces of minerals and vitamins. Fermented sago may contain more vitamins, especially the B group of vitamins. Sago is virtually an energy food only. Eating sago with meat, legumes and green vegetables will ensure a balanced and adequate meal.

***Coconut:* Cocos nucifera**

The coconut tree is a valuable staple and supplementary food in the Pacific. In most atolls, coconuts still make up a large proportion of the diet.



The coconut is believed to have come to the Pacific either from tropical America or from the shores of the Indian Ocean. Its spread throughout the Pacific must have been quite remarkable, for it still has the same common name, niu, throughout the Pacific.

The coconut is a tall palm with a long trunk and a crown of pale and dark green leaves. It can grow to a height of about 30 metres. When the fruit of the green, yellow or orange varieties of coconut mature and fall off, they can be left to sprout into a young coconut seedling that can be used as food or planted.

There are a number of varieties grown in the Pacific. The dwarf varieties grow to about 4 metres (14 feet) and flower about three years after planting. The tall varieties grow to about 25 metres (80 feet) and flower in about five to eight years. Some coconut trees are crosses between the tall and dwarf varieties. The coconut bears green or yellow-to-orange fruit all the year round. The nuts come in a variety of shapes and sizes and can be picked young or left to drop when mature.

In the atolls, where the coconut is a staple food, it has been found that people can eat up to five or six nuts per person per day (Coyne, 1984). Coconut meat (found inside the nut when it is cut), contains a lot of energy, in the form of fat, especially when mature. The mature nut is also a good source of iron, some protein and dietary fibre. Green coconut flesh contains less fat, but provides a very good source of minerals and vitamins. This makes it a very useful supplementary food for infants in atolls. In traditional meals the coconut provides the main source of fat.

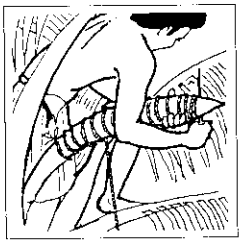
There are hundreds of ways of using both young tender nuts and mature nuts as food and also as a useful source of raw materials. Coconut water is an excellent rehydration fluid in areas where there is no clean water, sanitation is poor and water supply lacking. The meat of the young coconut can also be used in preparation of fermented dishes and coconut sauce or seasonings for vegetables and root crops, or cooked with other root crops to

enhance flavour. In the atoll island of Pukapuka in the Cook Islands, it is a traditional cultural practice for people to eat the whole fruit (flesh and coconut juice) and is often considered rude and disrespectful not to consume both.

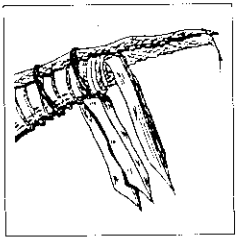
In other islands, the heart of the palm is boiled and also used in salads. Coconut toddy, a delicious and nutritious drink, is used in most atolls as a drink for infants and for those who need extra energy. The pictures below show how toddy is made:

1. Preparing the coconut flower.

2. Tying the flower and a few coconut leaves for tapping sap straight into containers.



3. Cutting the flower at the end in order to get the sap flowing.



4. Close-up view showing the leaves attached to the coconut flower stem.

5. Placing a container at the end of the prepared coconut flower to collect sap.

Toddy can be drunk fresh, boiled or slightly fermented. It is also boiled to form a thick syrup, which may be diluted to make drinks for the family or used as a sweetener. Fresh toddy is used as a morning drink in atoll countries. When slightly fermented it is boiled and made into an afternoon drink. Toddy is also a source of yeast that is used in baking. If fermented toddy is left for several days, it turns into vinegar, which can be used as a dressing and as a basis for coconut sauces served with fish. Fresh toddy contains some Vitamin C. Boiled toddy is a good source of niacin and riboflavin.

In islands where toddy is not produced, coconut sauce can be made using grated coconuts, seawater, and shellfish and used as a dressing, in vegetable salads or with other foods such as fish or shellfish. A Fijian method of using fermented coconut is to grate some mature coconuts, wrap the grated flesh in a softened banana leaf and leave for a few days to ferment. This fermented coconut salad (*kora*) is then ready to be mixed with *namu* (seaweed), diced onion, and other salad vegetables.

In many of the islands copra, which is the dried meat of the coconut, was the basis of a viable industry in the early days and is still so in some Pacific Island countries and territories. Traditionally the leaves were used to make houses and a variety of useful household tools. More modern coconut products include soap, cosmetics and furniture. The fibres are used for mattresses, mats and ropes, the shells for handicrafts, ornaments, charcoal and oil. Coconut oil is also used in cooking, but because of its low melting point and saturated fat content, it is not as popular as other types of oil.

The many other uses of the coconut and its products are too numerous to cover in this handbook. They make coconut a valuable resource for the Pacific. It is often referred to as 'the tree of life'. For more information on coconuts, please refer to South Pacific Foods Leaflet no. 8 (SPC, 1983c).

Despite the promotion of the coconut as a nutritious food, it continues to remain a controversial topic among health workers. The controversial part of the nut is the oil extracted from the mature flesh. Some United States scientists believe it contributes to the development of heart problems. This stems from the fact that coconut fat is highly saturated, its chemical composition being approximately 91 per cent saturated fat, 7 per cent mono-unsaturat-

ed fat and 2 per cent polyunsaturated fat. Consumption of saturated fats has been found to be a risk factor in non-communicable diseases such as cardiovascular disease (CVD) and obesity. For this reason coconut fat is labelled a 'bad' fat.

However, coconut oil neither lowers nor raises blood cholesterol levels. This special neutral feature is due to the chemical composition of coconut oil. More than two thirds of the fatty acids in coconut oil are of medium chain lengths of 8–12 carbon chains (C8–C12). However, it is the 14–16 carbon chains that are more associated with CVD. Fats that are composed principally of medium-chain triglycerides do not raise blood cholesterol levels when taken as part of a normal diet consisting of a variety of food every day (Nyam News, Caribbean Food and Nutrition Institute, November 1989).

The other controversial issue is coconut cream. In the Melanesian, Polynesian and Micronesian islands fresh or canned coconut cream is added to food during cooking. The freshly grated, mature coconut is squeezed into a wooden bowl or a basin using coconut fibres or a clean piece of cloth. This cream can be used in cooking, either diluted with water or concentrated (no added water). Coconut cream with no water has 32 grams (if canned, 16.8 grams) of saturated fat per 100 grams edible portion (English et al., 1996; Dignan et al., 1994). Use coconut cream in moderation if overweight or obesity is a problem.

Cassava: Manihot *species*

Cassava (or manioca, manioc, or tapioca, as it is sometimes called) is the most economical traditional staple food in the Pacific today. It is extensively grown in most parts of the Pacific because it is an easy crop to grow and harvest for the family. The plant is said to have been introduced to the Pacific from Mexico by the Spaniards and from Brazil by the Portuguese. There are several species, either white or yellow, grown in the Pacific, but the best ones include *Manihot esculenta* and *Manihot palmara*—the sweet species which contains less cyanogenetic glycoside than the bitter species, *Manihot utilissima* (Lambert, 1982).

Cassava can grow in light sandy soil or in dry or poorer soil where other crops may not grow well. It is grown from cuttings taken from the base of

the stem and may be planted all the year round. The roots can be harvested six to nine months after planting.

Baskets of cassava. Nuku'alofa markets, Tonga.

The best way to use cassava is to cook the tubers directly after harvesting. In areas where there is a constant supply of electricity, roots may be peeled, washed and then packed in clean plastic bags to freeze. Frozen cassava keeps for a very long time. In areas where there is no electricity, the roots can be placed in shallow pits and then covered with damp sawdust and or soil.

The roots may also be peeled, washed and sliced, then laid out in the sun to dry. The dry cassava can be kept in a clean airtight container until required. Roots are then soaked in water and pounded to make into flour. Cassava can also be fermented or made into chips. The fermentation process is described in Section IV—Use of traditional staple foods.

Although the cassava roots have much more energy than other root crops, this food is not as nutritious as taro, yams and sweet potatoes. Table 6 compares the nutrient content of different raw staple foods in the Pacific.

Table 6: Comparison of nutrient content of different uncooked (raw) staple foods in the Pacific (per 100 grams)

Nutrients	Yam	Sweet potatoes	Taro	Cassava
Water	74.00	71.00	69.00	63.00
Energy	414.00	460.00	490.00	610.00
Protein	2.00	1.40	1.10	0.50
Calcium	8.00	29.00	32.00	20.00
Iron	0.80	0.40	0.50	0.20
Vitamin A	0.02	0.01	0.10	trace
Vitamin C	20.00	24.00	15.00	15.00
Riboflavin	0.03	0.03	0.03	0.05
Nicotinic acid	0.40	0.60	0.80	0.60
Thiamin	0.05	0.09	0.03	0.05
Dietary fibre (%)	1.20	1.60	1.50	1.50

Source: Bradbury & Holloway, 1988.

Breadfruit: Artocarpus *cultivars*

Breadfruit has long been an important staple crop in the Pacific Islands, where it is part of an agricultural complex well adapted to island environments. It is an excellent energy fruit/staple tree that requires very little care. It probably came to the Pacific approximately one to two thousand years ago through the eastern parts of the Malay archipelago (Barrau, 1973). It now grows wild throughout Asia and the Pacific. There are many varieties and these vary from island to island. There are two species of breadfruit in the Pacific Islands, *Artocarpus altilis* in the Melanesian and Polynesian Islands and *Artocarpus mariannensis* found throughout Micronesia (Ragone, 1996). Breadfruit is an important staple in atolls because it is one of the few starchy staples that can thrive in the atoll environment. Different varieties fruit at different times, thus providing for continuous food supply each year. The importance of breadfruit has diminished in the past 50 years and replanting has not kept pace with the losses incurred throughout the Pacific from drought, storm damage, attrition by age and other factors.

Young shoots or suckers as well as root cuttings are used as planting material. Seeds obtained from ripe fruits can also be grown. Once growing, breadfruit trees do not need much care, except in atolls, where they may need water and manuring with compost. Breadfruit trees can grow up to 18 metres (60 feet) tall and begin to fruit after about six years. They can produce fruit for 50 years or more.

Breadfruit: not as popular now as it used to be.

Because breadfruit is very seasonal, a lot of work has to be done (quickly) to preserve this tasty starchy fruit. Traditionally, to avoid wastage if there is excess mature fruit on a tree, they are picked, peeled, washed and put in a pit lined at the bottom with clean green banana leaves. Then more leaves are folded over so that the food is sealed inside. More dry leaves are added, and finally stones or heavy logs are put on top of the dried leaves. This fermentation process is effective and will help to preserve the paste for months.

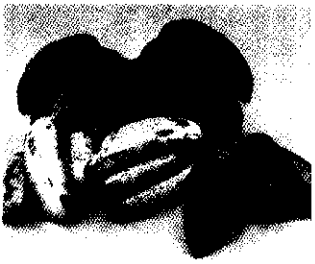
For use as palatable food, the fermented breadfruit can be pounded till smooth and flavoured with coconut. Balls of the mixture are then wrapped in breadfruit or banana leaves and can simply be baked in the earth oven or roasted over hot coals.

The mature breadfruit can also be baked with the skin intact. The cooked flesh can be extracted and pounded to make breadfruit dough. This is cut into portions and served with coconut sauce, as in Wallis and Futuna and other Polynesian islands, or with a sweet sauce made from coconut and caramelised sugar. Chips can also be made from breadfruit. Leftover boiled breadfruit can be made into a salad, or fried.

Breadfruit is an excellent energy food. It is a good source of dietary fibre and a reasonable source of Vitamin C. Breadfruit seeds are a useful source of protein and thiamin. They provide a good snack food for school children.

Bananas and plantains

Bananas and plantains are most important staples and are also a valuable food for commercial production. They can be grown in most Pacific Island countries and territories. There are two types, the eating banana (*Musa esculenta*) and cooking banana (plantain). Both types belong to the species *Musa*.



This section will deal with plantains or cooking bananas. In our next handbook, *The Fruits We Eat*, eating bananas will be discussed. In some Pacific Islands some species of cooking banana can also be eaten uncooked when ripe.

Bananas grow in most parts of the Pacific, even in atolls. They grow well in warm climates and need plenty of water to produce the fruits that are the energy-food source. They can be grown in different kinds of soil, but do especially well in loose topsoil on top of a heavy clay soil. One problem with bananas is that they are easily destroyed in cyclones. To minimise damage, there have been attempts to grow dwarf bananas and/or to trim trees before a cyclone hits. SPC Handbook no. 5, *Banana Production in the South Pacific*, outlines preparation, planting and agricultural management and production of bananas in the Pacific.

Plantains can be grown from a young shoot or corm (the 'root' of the banana tree). The plant can grow to a height of 3–8 metres (10–25 feet). It takes approximately a year after planting for plants to fruit and they may fruit at any time if the weather is warm. Plantains are normally grown with other crops such as yam and taro (inter-cropping), so that they provide shade for these.

When plantains mature, they are usually cut down before they ripen and hung in a dark, cool place. When required, the fruit, either green or ripe, can be boiled, baked or steamed. Under warm conditions, plantain can ripen very quickly. Ripe plantain can be eaten fresh or made into delicious cooked puddings.

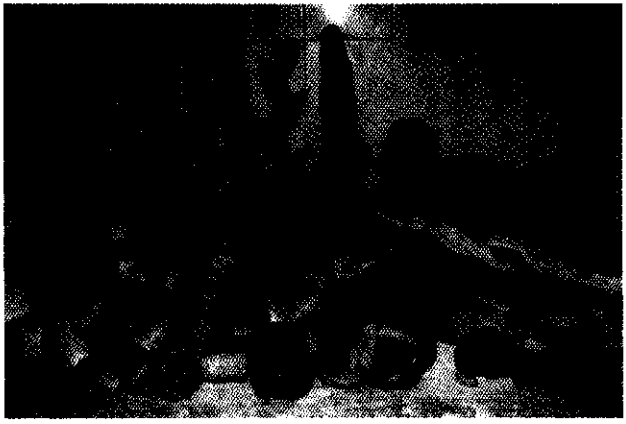
Plantains provide a lot of energy and are good sources of Vitamin C and Vitamin A, contain some dietary fibre, and are high in potassium (approximately 400 milligrams/100 grams).

2. Imported staple foods

Bread and other flour products

Bread is a mixture of ground grain or flour and water, with or without yeast, salt, milk and other ingredients. The Greeks were the first to promote white bread as a superior product and only the poor used to eat wholemeal bread. Today bread (white or wholemeal) is more easily available, because of its convenience and price, than the same quantity of traditional staple food sold in the shops.

The art of bread making is not new in the Pacific Islands. Many different kinds of bread are produced in the Pacific, ranging from the normal white loaf to bread rolls, buns, baguettes, and wholemeal and brown bread.

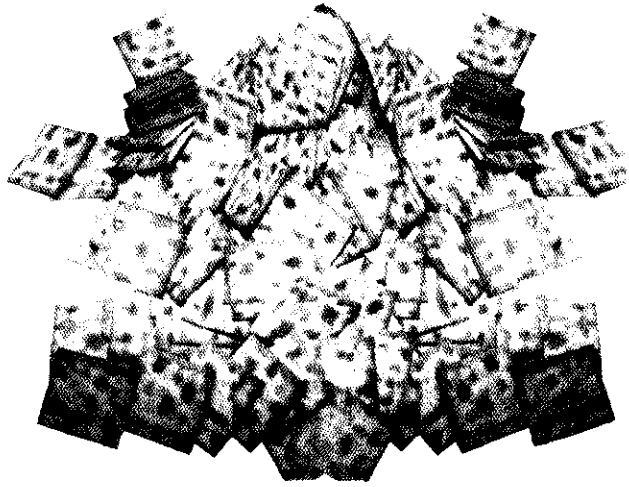


A variety of breads, typical of New Caledonia.

Although most people in the Pacific now eat bread, cakes, buns and other flour products made from imported wheat flour, flour can also be made from the many different starches found in root crops. The starch grains are all different and can be easily identified under the microscope (Egan et al., 1981). If starch from different root crops could be used to replace some wheat flour, this would be of great benefit to the people of the region. It would increase the value of their local root crops and would also lower the cost of bread production. A full description of the composition and properties of breads made from different starches is given by Tsen (1979).

Cabin biscuits

Local biscuits (often made overseas especially for the Pacific Island taste and teeth!) are amongst the range of introduced flour products that are popular with the young as well as the elderly in the Pacific. Although some are made locally, others, such as cabin crackers and biscuits, are still produced overseas especially for the Pacific Island market. One reason for their popularity is that they can be stored for a very long time (if kept in tins), compared with fresh bread. Thus they have become a useful food commodity, especially for those living in the atoll islands where fresh bread is not so easily available on a daily basis.



Most of the islands have their own version of island biscuits and while they may differ in shape and size, the basic ingredients remain roughly the same: flour, water and some fat or oil, made into a dough, rolled, cut into shapes and baked.

Two types of Pacific Island biscuits have been analysed in two Pacific Island laboratories—the PNG University of Technology and the University of the South Pacific. The Fiji breakfast cabin crackers appear to be much higher in energy, dietary fibre, fat and sodium than the PNG biscuits. This apparent difference may be due to the difference in the analytical methods used and variations in the moisture content of the two samples.

Flour

Flour imported into the Pacific mostly comes from New Zealand and Australia. A fair amount is also donated to the islands through disaster-relief programmes. Most of the flour imported is refined white flour. This is because it can be stored for a very long time provided it is kept in a dry container.

Wholemeal flour, on the other hand, does not keep very well. It tends to attract insects and moulds more quickly than white flour. Wholemeal flour contains more complex carbohydrates and dietary fibre than white flour and so it is a better, healthier choice for the family.

Rice: **Oryza sativa**

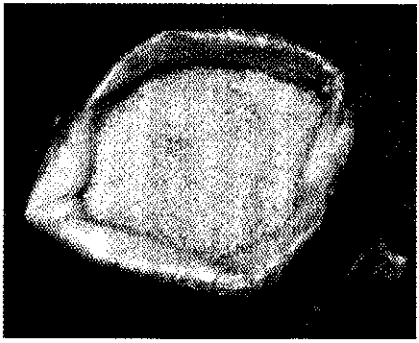
The islanders of Guam were growing rice prior to European colonisation. It was also introduced to New Caledonia as early as the 1850s. Rice production then extended to PNG and Fiji, where it was grown during the 1950s and is still growing today. There is still a viable and growing rice production industry in PNG. Today imported rice is a staple in many atolls. It has also been a staple food in Fiji since the Indian settlement. However, a major part of the rice needed for food in the Pacific is still being imported from Australia, New Zealand and the United States.

Rice is said to have originated in India. It was also used as a staple in China 5000 years ago. Rice needs plenty of water and a warm humid climate. It is mainly grown in rice paddies submerged in water until the rice is ready to ripen. The paddies are then drained and the rice is picked and harvested by machines. There are also dryland types of rice.

Attempts made to grow rice in the Pacific as a cash crop were not very successful; local rice could not compete with high-quality imported varieties from rice-growing countries. Additionally, the costs of production in Pacific Island countries and territories are high, enabling imported rice to be sold more cheaply in stores than the locally grown varieties. It was also thought that island economies should maintain and encourage the production of local staple food crops because they were not only nutritionally superior, but could produce higher yields.

The most commonly eaten type of rice in the Pacific Islands is the polished white variety, which has gone through a milling process that removes the bran and

most of the dietary fibre, minerals and vitamins. Parboiled rice that has been partially cooked with the bran still intact and then removed is also available.



Rice: a cheap convenient staple.

Rice can be boiled and served in place of or together with root crops, or boiled in thin coconut cream and served as a breakfast dish. It can also be cooked with meat or fish or chicken to make thick soup or made into fried rice. Plenty of green and yellow vegetables can be added to rice to make a healthy nutritious meal.

***Common potatoes:* Solanum tuberosum**

Early settlers, Europeans and missionaries, who were not used to the taste of the local staple foods, probably introduced common potatoes to the Pacific Islands. According to Barrau (1956), *Solanum tuberosum* was grown in some island territories in the early 1950s mainly to supply European settlers.

Potatoes are indigenous to Central and South America. Their cultivation dates back approximately 4000 years. Spanish explorers introduced potatoes to Europe, where they became a staple crop in the period 1650–1750.

Potatoes have been successfully grown in the highlands of PNG, at Sigatoka (Fiji), in Tonga, where they became a popular crop amongst the islanders, and on Tanna Island in Vanuatu. Potatoes were also promoted during the early 1970s, mainly through overseas aid agencies, as a short-term viable crop for disaster rehabilitation. In other parts of the Pacific they

were also imported. Today several varieties could be grown in many islands in the Pacific, but the supply is not enough to cater for local needs. Some are still imported.

The potato tuber is the swollen tip of an underground stem. The energy is stored in the stem in the form of starch. It can yield more energy than cereal grains and this makes it a convenient crop to grow, particularly in areas with loose soil and low temperatures.

Choosing the best potatoes for cooking can be a problem if people are not aware of a few characteristics of this useful plant. One type of potato is the 'mealy' type, in which the cells tend to separate out when cooked. These are best for baking and for preparing mashed potatoes. The other, 'waxy' type is best for scallops, chunks, and wedges that can be chopped up for potato salads.

Some potatoes tend to develop 'stem-end blackening' during cooking. This is caused by a reaction of ferric iron (Fe^{+++}) ions, formed from ferrous (Fe^{++}) ions during cooking, with phenolic substances inside the potato. Some potato varieties may be more susceptible than others. Stem-end blackening can be avoided by adding half a teaspoon of cream of tartar for every pint of cooking water, after the potatoes are half done.

Generally ordinary potatoes contain a lot of starch, and moderate amounts of protein and Vitamin C. If new potatoes are cooked and eaten in large amounts they can provide enough Vitamin C to prevent scurvy.

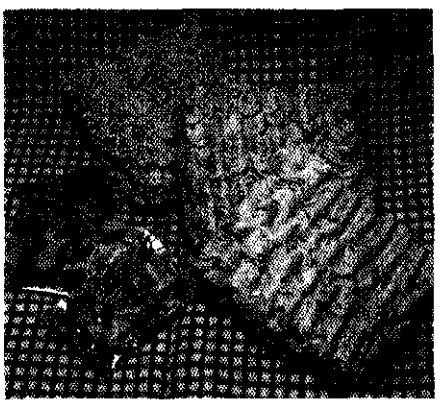
Common potatoes need to be kept cool and reasonably damp. In temperate countries, they are usually kept in heaps covered by straw and soil during the winter season. In the tropics they need to be kept in a cold store at about 3–4°C or in a refrigerator.

Pasta (noodles)

Pacific Islanders tend to call pasta 'noodles', whereas Europeans term everything 'pasta'. Noodles originated in Asia in about 1000 BC. They appear to have been increasing in popularity in the Pacific, especially in Micronesia, in the last 20 years, due to the increased influence of the Asian

food market and the relative ease of preparation. Noodles are increasingly used in the Polynesian and Melanesian Islands too.

European-type pasta is made from the endosperm of a hard variety of wheat called durum wheat. It is mixed with water to form dough, cut into strips of various shapes and boiled until tender. Some types of pasta, such as noodles, may also have added eggs and/or vegetable extracts. These give a softer flavour and improve the nutritional quality of the pasta. The Italian word 'pasta' means 'paste' and refers to the dough made by combining the wheat flour (called 'semolina') with water.

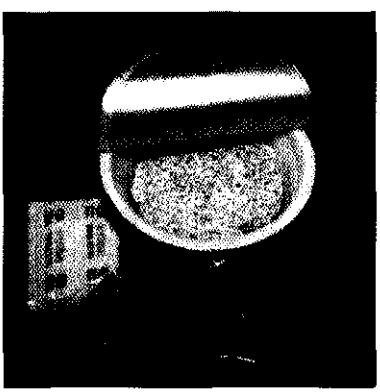


The harder the wheat used for making pasta, the stronger the dough. Pasta made from weaker flours breaks easily. Macaroni or spaghetti is popular, though each category has many size and shape varieties.

It was in Italy that the art of pasta making was perfected, so many kinds of pasta bear Italian names. Macaroni products can be divided into four basic groups: cords, tubes, ribbons and shells. They range from the wide lasagne sheets to the simple noodles that are readily available in many shops and supermarkets in the Pacific.

In Asia noodles are made from rice or soybean flour rather than wheat flour.

Both pasta made from wheat flour and noodles made from rice flour are imported into the Pacific. They are available in fresh or dried form. Pasta is mostly used in Italian, Mediterranean and European dishes and noodles in Asian and Pacific recipes.



Pasta and noodles are good energy foods. They contain complex carbohydrates that can release energy very slowly over a long period of time, thus providing bulk to the diet. Cooked pasta or noodles can be mixed with other food, such as meat, fish and vegetables, to make a healthy nutritious meal. Pasta can also be served with a wide variety of sauces. Wholemeal pasta provides a good source of dietary fibre.

In the Pacific there is a preference for plain noodles to be cooked and fed on their own as a weaning food to young children under five years on a daily basis, in the same way as rice. Other foods, such as green and coloured vegetables mixed with protein foods, should be added to improve the nutrient values of noodles if given to infants.

Cooking pasta or noodles can be quite an experience, especially for first-timers. Here are a few hints on how to successfully cook pasta or noodles:

1. Use a large pan and plenty of lightly salted water. This is because pasta and noodles increase about three times in volume during cooking.

2. Use about 1.2 litres of water to every 120 grams of pasta or noodles.

3. Put all the pasta or noodles into the boiling water.

4. Bring the water to the boil, check the cooking time on the label and cook accordingly.

5. Stir the pasta or noodles occasionally during cooking to stop sticking.

6. Use a fork to check if the pasta is cooked. It should be firm and not too soft.

7. Drain and serve hot, or if pasta is to be used as a salad, rinse under cold water to cool before mixing with other ingredients.

Noodles or pasta are not fattening if boiled and served with other foods. However if you eat too much of any of these foods on its own you can gain weight.

A half-cup serving of cooked pasta contains 99 calories and less than half a gram of fat. (Compare this to a 3 ounce serving of skinless, roasted chick-

en breast, which has 6.6 grams of fat, and a 3 ounce serving of lean grilled ground beef, which has 13.5 grams of fat.)

Dried noodles or pasta last much longer if they are stored in an unopened packet or airtight container. Fresh noodles or pasta of all kinds should be refrigerated until needed and used the same day they are purchased.

Note: A staple food that has not been covered in this book, but is a major staple of Micronesia, is pandanus. It can be made into starch as part of the main meal or eaten as a fruit. It will be covered in our next handbook, *The Fruits We Eat.*

Pandanus — *covered in* The Fruits We Eat.

Mackerel dip and crusty bread

Ingredients:

1/2 cup sour cream
1 tablespoon lemon juice
1 tablespoon mayonnaise
1 tablespoon green onions finely chopped
300 grams cooked mackerel (or canned)
Pinch of dry mustard, pepper, salt to taste

Method:
1. Whip cream until thick. 2. Blend remaining ingredients (or stir in).
3. Chill before serving. 4. Serve with toasted bread.

Serves 4–6

VII. The Future of Staple Foods in the Pacific

Food and nutrition policies

As a result of regional nutrition meetings and documented evidence of the increasing trends in nutrition-related health problems and diseases, Pacific Island governments have been very active in developing national food and nutrition policies. They have been assisted by the Secretariat of the Pacific Community (formerly the South Pacific Commission), the World Health Organization, the United Nations Children's Fund and the UN Food and Agriculture Organization. The production and consumption of traditional local foods, such as coconuts, bananas, taro, sweet potatoes and yams, has been encouraged in most countries and territories, as has the development of food standards and regulations regarding food imports.

However, local consumption of traditional staple crops has been declining for many years and is not likely to increase. In many countries and territories, food cultures have changed as people became more affluent. Many of the old labour-intensive traditional recipes are not used any more and younger generations have different priorities from those of their parents. Food policies can only reflect the will of the people and nutrition policies can only reflect the needs of the people. Both food and nutrition policies can only allow people to choose from a wide range of nutritious foods and make the choices as easy as possible. The final arbiters are the people themselves and at present, imported foods present the easy choices.

Nevertheless, the development of local cultivars of certain starchy staples that have shorter growing seasons and less acridity is being undertaken in many Pacific Island countries and territories to increase local food production. Continuous promotion of the importance of indigenous staple foods by nutritionists and nutrition workers in the Pacific is an ongoing struggle against cheap, convenient imported foods. Many islands have established national food and nutrition committees. These assist with planning and development of strategies for improving production, preparation and consumption of foods grown locally, whether they are indigenous or not.

Household food security

The family food garden has been a tradition in the Pacific since the islands were first inhabited. Its promotion as a means of ensuring that Pacific families and households are nutritionally secure is of the utmost importance. On-going programmes re-emphasise and improve semi-subsistence farming practices, especially for those in urban areas and for people on a low income. Continuing promotion of family food gardens and of strategies to maintain a safe, nutritious food supply for the family and the Pacific communities should be given priority by local, regional and international organisations. Additionally, education of government officials on food security issues is now being given priority by most Pacific Island countries and territories.

Pacific Island culture (like most others) is continually changing. The younger generations do not seem very interested in household food security initiatives. Efforts to refocus and reorient community-based programmes so that they are innovative and involve young people are very important. Promotion, consultations, education and participation of young people in agricultural programmes and training are crucial. Understanding the importance of local foods, especially staples, for the health and wellbeing of Pacific Island populations is a key factor.

Pests and diseases

The impact of pests and diseases holds grave fears for Pacific Island planters and farmers. A few are described below.

The coconut palm rhinoceros beetle (*Oryctes rhinoceros*) was introduced into the region through Samoa in 1909. It is now present in American Samoa, Fiji, Tokelau, Tonga, Wallis Island, Samoa and Palau, as well as parts of PNG (East New Britain, Manus Island and New Ireland). The adult beetle burrows into the apex of the palm and feeds internally on soft developing fronds before they have unfolded. When the damaged fronds unfold, they show large angular cuts in the sides of the frond, while sometimes the end of the frond is completely cut off. Heavy attacks kill the trees, while intermediate attacks weaken the palm tree and reduce nut production (SPC, 1977).

Banana diseases cause heavy losses of crops. In 1913 in Fiji, the disease called *Cercospora musae*, which attacks the leaves of the banana, caused Sigatoka disease (black leaf streak). In 1963 another wave of more severe black leaf streak was first noticed in Fiji. The banana industry suffered from the attacks of these diseases (Lambert, 1970).

Phytophthora leaf blight (taro leaf disease), common in Samoa, American Samoa, Kiribati, Vanuatu, the Solomon Islands and PNG, has had a major impact on both export trade and local consumption. Since the outbreak in Samoa, exports of taro have dropped in value from ten million Samoan dollars to approximately one hundred thousand dollars. Bananas have now replaced taro as the most important food crop. This change will also have an adverse effect on the traditional staple-food-consumption patterns of Samoans.

Insect pests of major importance in some countries and territories are the taro beetle, taro army worm and the giant African snail.

It is debatable whether the present population of the world could be fed without the use of pesticides because large areas of a single food crop (monoculture) are more susceptible to pests than small plantings of different crops. The use of pesticides raises environmental issues that only local communities and governments can resolve.

Some Pacific Island governments are not developing environmental protection programmes to preserve the environment and control outbreaks of pests and diseases. If such programmes are not developed or are unsuccessful, many Islanders will become fully dependent on introduced foods. Countries and territories in the Pacific must practise vigilant quarantine and early detection to prevent the introduction and spread of pests and exotic diseases of staples in the region.

Pacific taste

The natural quality, especially the taste, of Pacific foods is very high and should be maintained. The priorities and requirements of the commercial markets and distributors do not focus on taste. Commercial food production industries strive for high yield, long shelf life and ability of fruits to resist pests and diseases. This is often at the expense of taste. Ask any Pacific Islander where

the best-tasting root crops are—you will be told 'in the Pacific Islands'. A marketing edge lies here waiting to be exploited.

The idea that it is impossible to obtain all the vitamins from our present food supply has prompted part of the Pacific population to supplement its diet with additional vitamins and minerals. Vitamin deficiency resulting from poor eating habits is obviously best treated by correcting the diet.

New processes

In developed countries, improvement of staple foods by biotechnology has been taking place for a number of years. Pacific countries and territories could benefit from these recent advances to improve the shelf-life and storage ability of many Pacific foods. However, the ethical issues related to these processes have yet to be resolved. In the United States and Europe, there is a demand by consumers for such genetically engineered foods to be labelled, but at present there are no labelling laws requiring producers to reveal whether a food has been genetically altered. With the introduction of free world trade into the Pacific, food-safety laws need to be in place to protect and inform people about genetically engineered foods and inferior-quality foods.

Food irradiation is a new method used to preserve food. This technique involves using ionising radiation to destroy various micro-organisms or to inhibit biochemical changes. In some developed countries questions about the safety of this method are causing public concern. Food irradiation is not permitted on a commercial scale, although the joint FAO/WHO Codex Alimentarius Commission has accepted it as a safe and effective technology when used under good manufacturing practices.

Major factors affecting food supply are climate and political instability. Major famines are always a risk, but by far the greatest risk is political instability and, ultimately, war. We have no hope of dealing with population and environmental problems if we cannot manage our political problems.

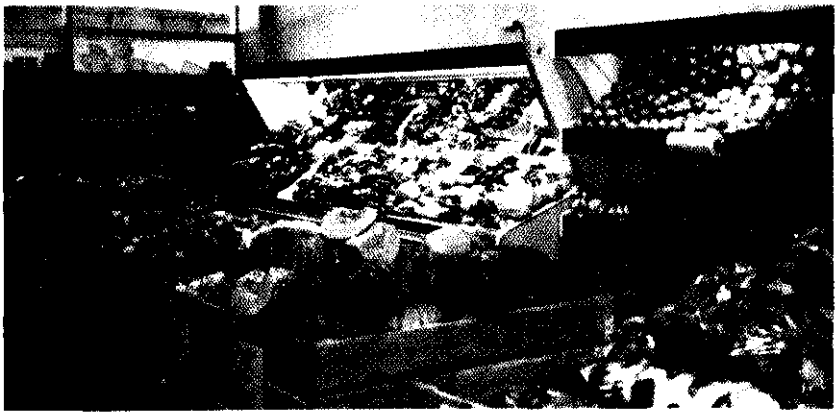
Some conclusions

Food culture has slowly been changing in Pacific Island countries and territories for some time and there has been a shift away from traditional root

crops to cheaper, more convenient imported staples. However, for formal and ceremonial occasions, local foods are essential. More kinds of food are now available in the Pacific Islands. With such an abundance, choice is usually determined by price and convenience. In urban areas, polished rice and wheat flour are cheaper and easier to prepare than root crops.

Imported staples have different nutrient profiles and pose the threat of over-consumption of energy and fat, and under-consumption of fibre. The challenge for nutritionists and dietitians, horticulturists, policy makers, economists, school teachers and home economists is to advise and support the public on foods beneficial for health, and at the same time promote awareness about the benefits of production and consumption of local staples.

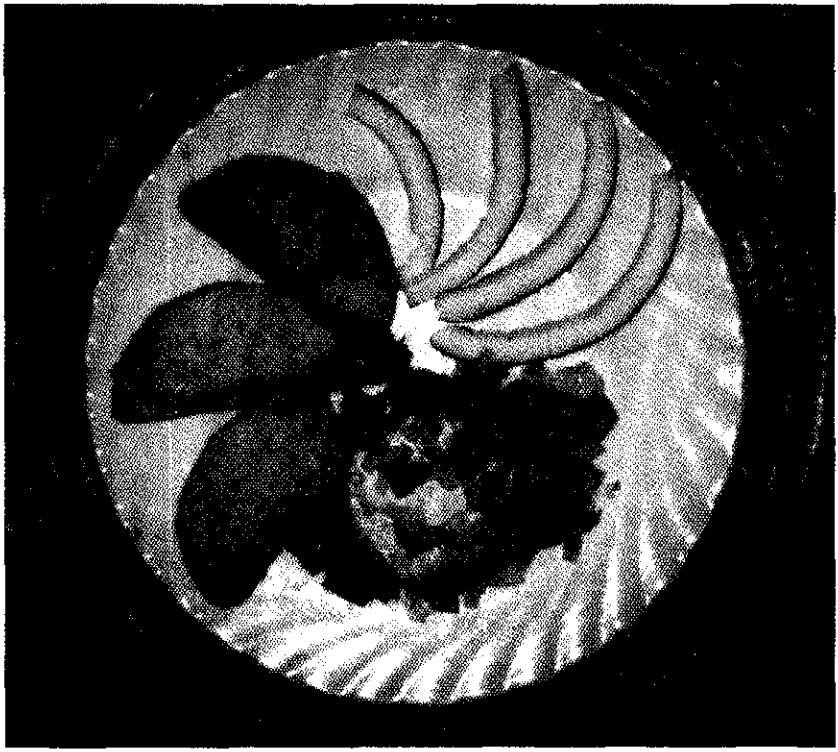
Growing contact with the western world and increased urbanisation are rapidly changing food habits in the Pacific. However, the value of traditional staple foods in the Pacific Islands is assured despite the continuing threats from politics, natural disasters, pests, environmental pollution, migration and lifestyle changes. The strong cultural and spiritual ties with the land and the sea will ensure that Islanders appreciate their social, psychological and cultural heritage and the roles they play through the foods they consume. Without doubt, traditional foods will always play an important part in the lives of Pacific Island people.



Fish with pineapple and carambola

Ingredients:

2 small fish (1.5 kg)
1/2 ripe pineapple
2 onions
1 carambola
2 cloves garlic
2 chillies
1 teaspoon sugar
2 tablespoons lemon juice
2 tablespoons oil
1 cup coconut cream
Seasoning
Taro
Coconut



Method:

1. Stir fry chopped onion and crushed garlic. **2.** Add lemon juice, sugar, chillies (crushed/chopped). **3.** Add diced pineapple, fish cutlets and carambola wedges. **4.** Add coconut cream and simmer 10–15 minutes. **5.** Season to taste. **6.** Serve with taro and coconut as pictured.

Serves 4

VIII. Nutrient Composition

Nutrient values are shown in Appendix 1 Table 1 and Figures 1–14. These assist readers to compare the amount of a particular nutrient in each staple food with the amount in others, as well as making comparisons between traditional and introduced staple foods. They can also be used by health and nutrition workers to prepare overheads for use as teaching resources.

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Appendix 1

NUTRIENT COMPOSITION OF SOME STAPLE FOODS

Table 1: Nutrient content of selected foods in the Pacific per 100 g of cooked food

	Water	Energy	CHO	Fibre	Fat	Protein	Ca	Fe	Na	Vit C	B1	B2	Vit A	K
	g	kJ	g	g	g	g	mg	mg	mg	mg	mg	mg	ug	mg
Noodles (2 min type)	73.0	406	14	0.9	3.6	2.6	8	0.8	7	0.1	0.10	0.00	0.0	30
Potatoes	79.0	266	13	1.1	0.2	0.6	2	0.5	7	21.0	0.07	0.02	0.0	413
Rice (imported)	69.0	523	25	0.6	0.2	2.3	4	0.3	5	0.0	0.03	0.01	0.0	10
* Flour	12.0	1440	73	3.8	1.2	10.8	18	1.0	2	0.0	0.27	0.15	0.0	162
Cabin biscuits (Fiji)	3.1	1774	77	2.1	8.0	10.6	20	1.9	648	1.0	0.19	0.03	0.0	171
Cabin biscuits (PNG)	10.0	1540	76	0.5	3.4	9.7	27	1.0	460	0.0	0.23	0.07	0.5	141
Bread (white)	39.0	992	47	2.7	2.9	8.2	32	1.1	450	0.0	0.13	0.08	0.0	110
Bread (wholemeal)	40.0	921	39	6.5	2.9	10.1	54	2.3	470	0.0	0.23	0.12	0.0	270
Banana/Plantain	69.0	455	26	1.2	0.9	0.8	5	0.5	4	9.0	0.03	0.04	19.0	400
Breadfruit	81.0	293	14	2.5	0.2	1.3	13	0.9	1	22.0	0.08	0.05	5.0	350
Cassava	65.0	542	32	1.5	0.2	0.5	20	0.2	7	18.6	0.04	0.02	0.3	289
* Coconut (mature)	54.0	1120	4	7.6	27.4	3.0	10	1.0	16	6.0	0.04	0.03	0.0	340
* Sago flour	13.0	1390	83	0.5	0.2	0.4	9	0.7	3	0.0	0.00	0.00	0.0	5
Sweet potatoes (white)	77.0	313	17	2.0	0.1	1.4	13	0.5	12	19.0	0.14	0.03	3.0	182
Sweet potatoes (yellow/orange)	79.0	269	14	2.3	0.1	1.9	26	0.5	10	23.0	0.02	0.05	960.0	225
Taro (red)	72.0	429	24	1.0	0.4	0.9	37	1.1	7	8.0	0.09	0.03	6.0	264
Taro (white)	75.0	407	22	0.8	0.6	0.9	34	1.0	1	5.0	0.05	0.03	6.0	264
Yam	72.0	338	18	1.5	0.1	2.0	7	0.6	3	12.4	0.04	0.03	15.0	221

* *uncooked*

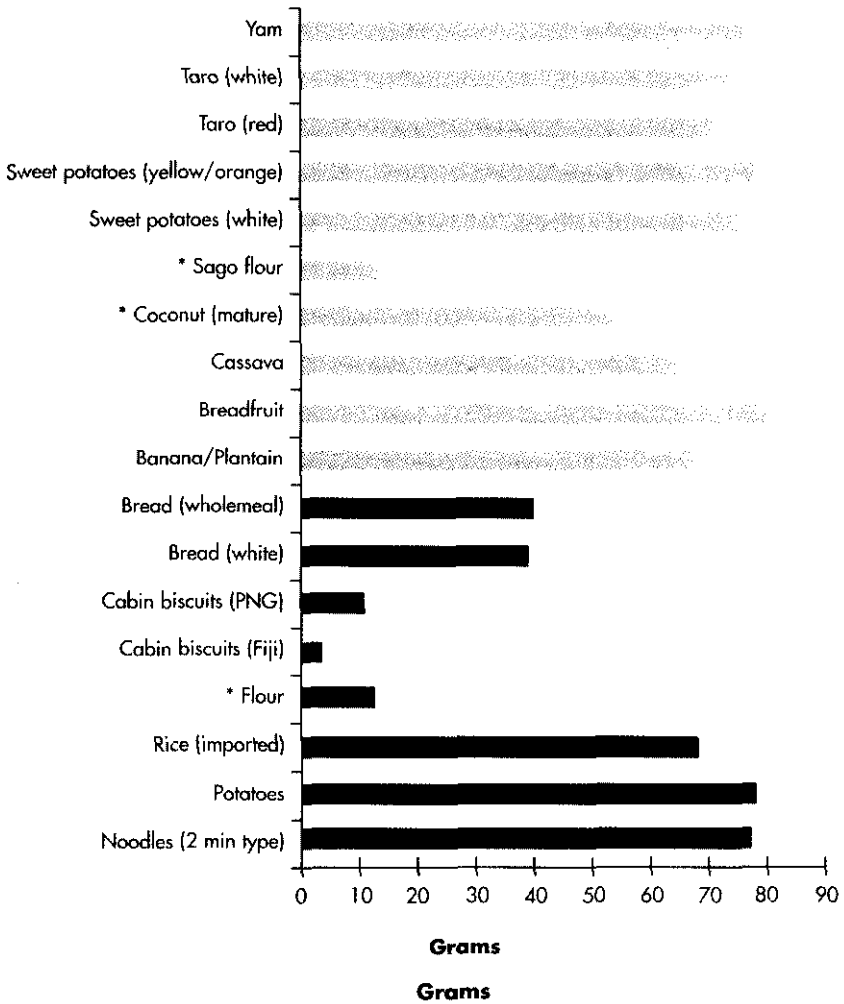

Figure 1: Weight of water per 100 grams of cooked food

Local foods
Imported

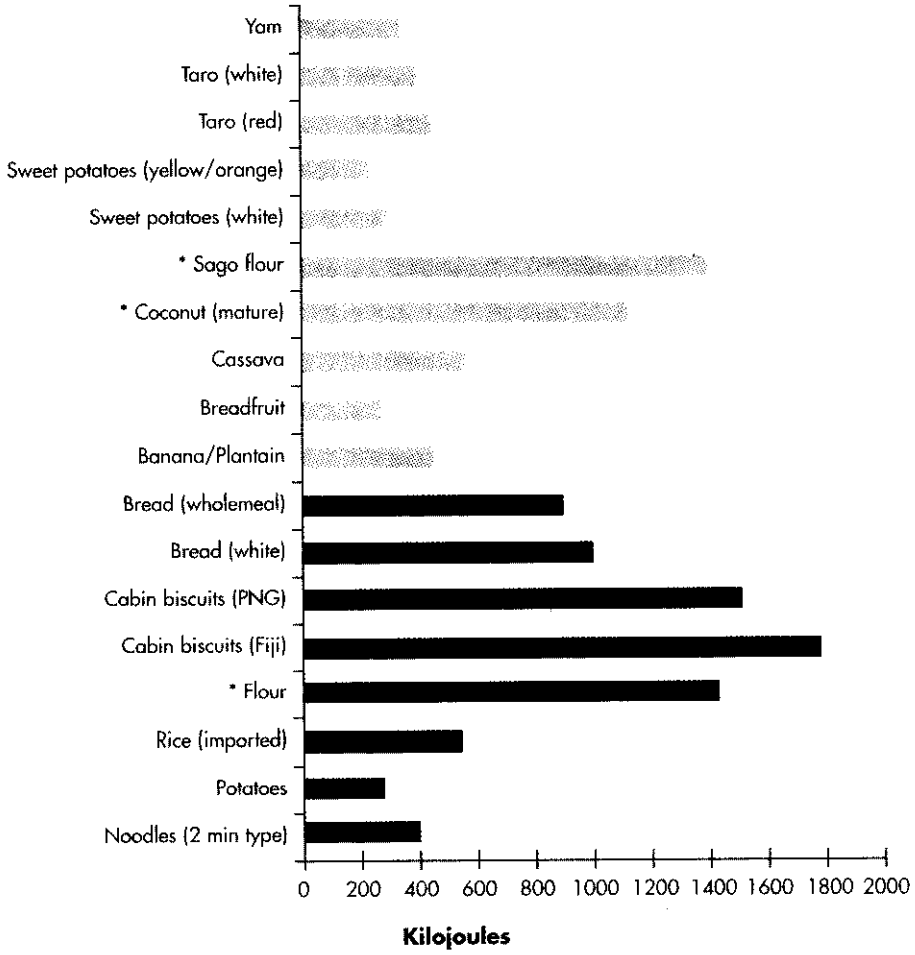

Figure 2: Energy content (kJ/100 grams) of cooked food

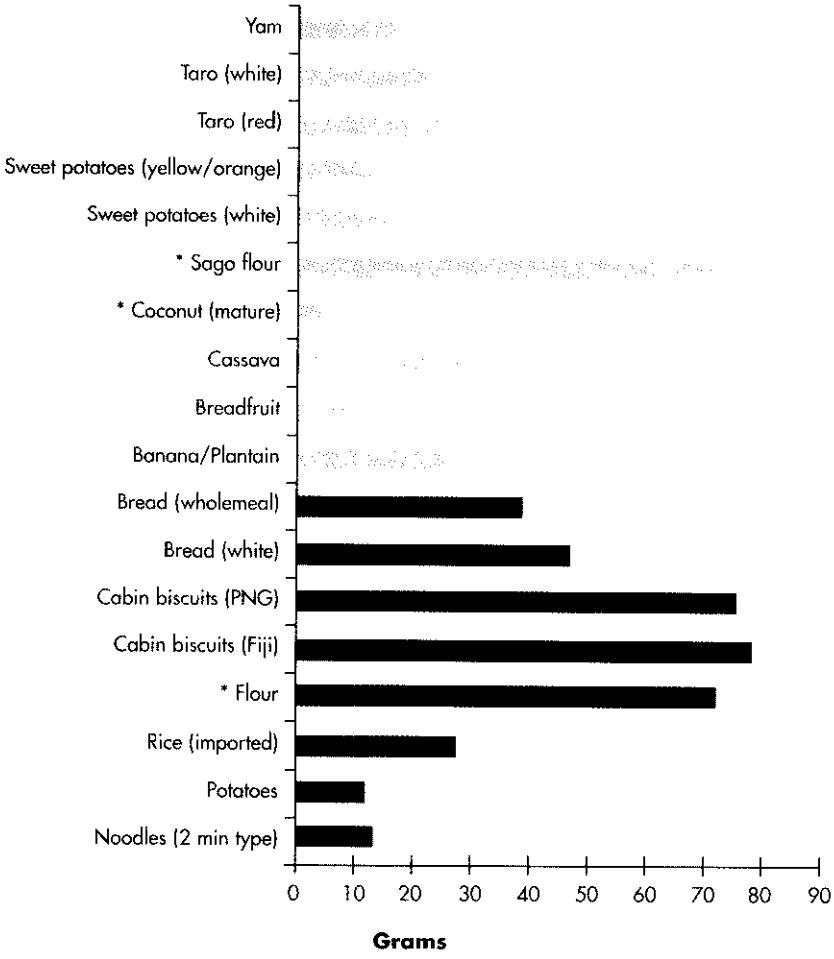

Figure 3: Carbohydrate content (grams/100 grams) of cooked food

Local foods
Imported

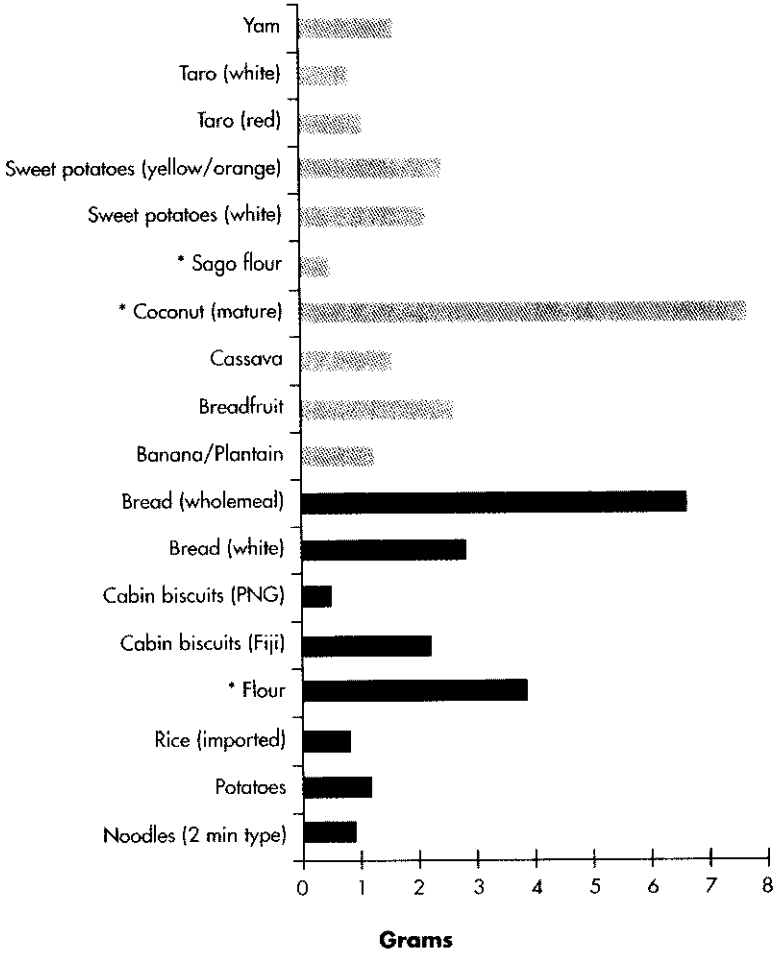

Figure 4: Fibre content (grams/100 grams) of cooked food

▒ Local foods
■ Imported

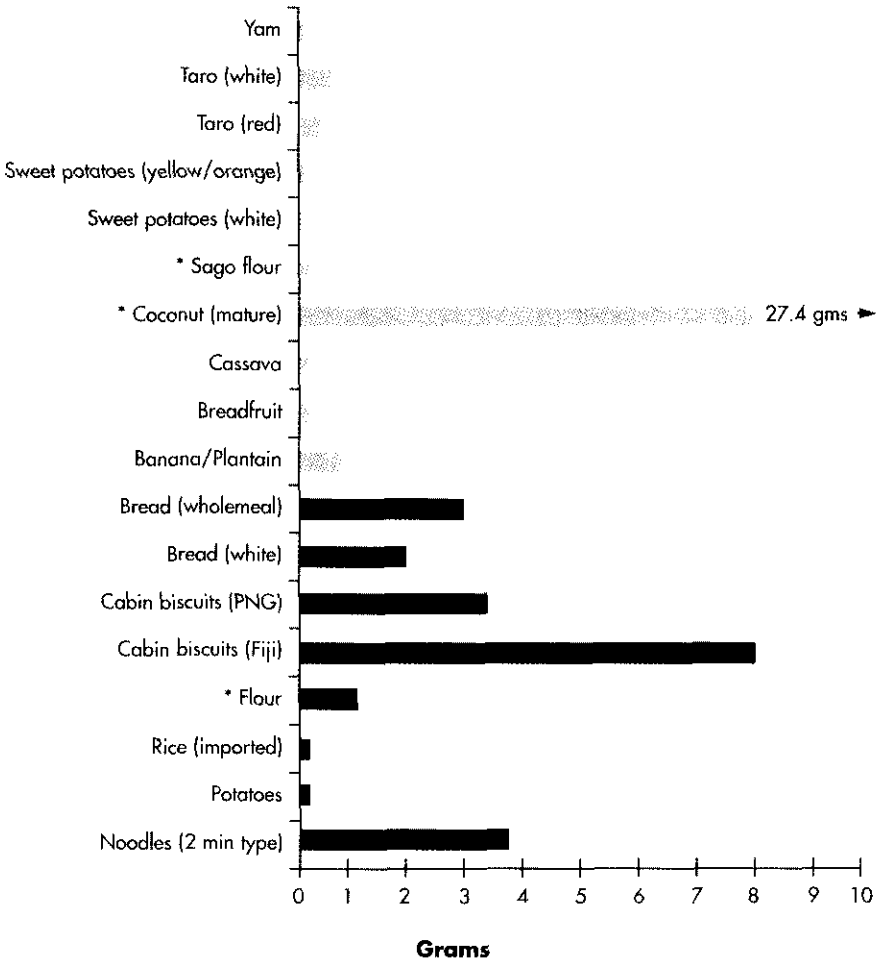

Figure 5: Total fat content (grams/100 grams) of cooked food

Local foods
Imported

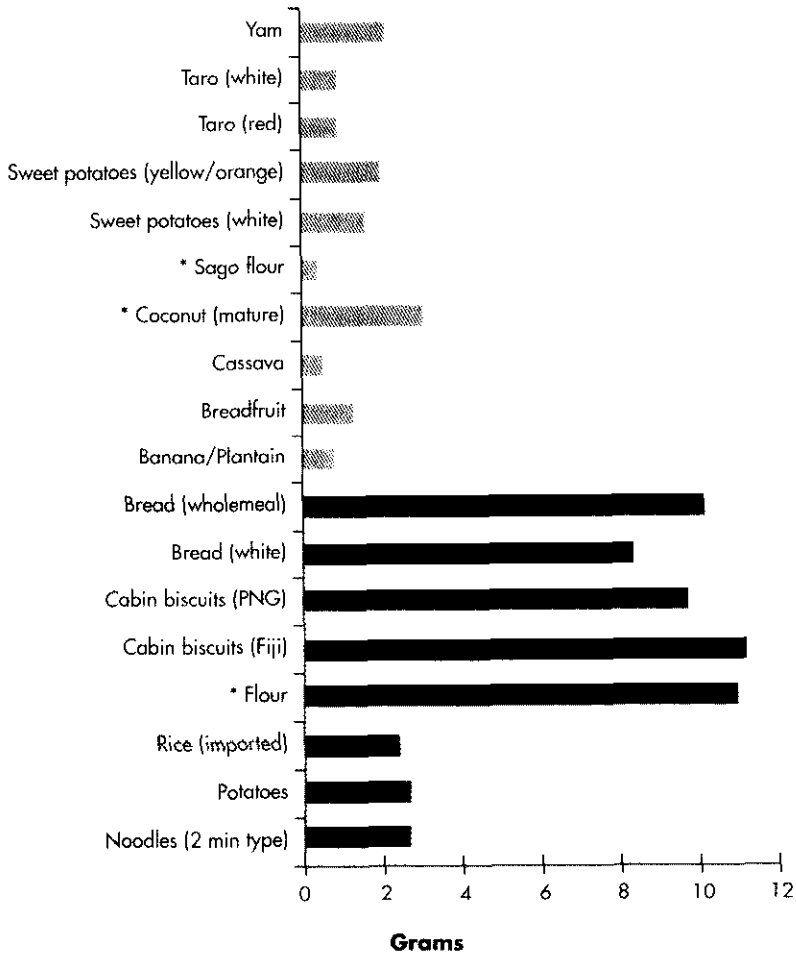

Figure 6: Protein content (grams/100 grams) of cooked food

▨ Local foods
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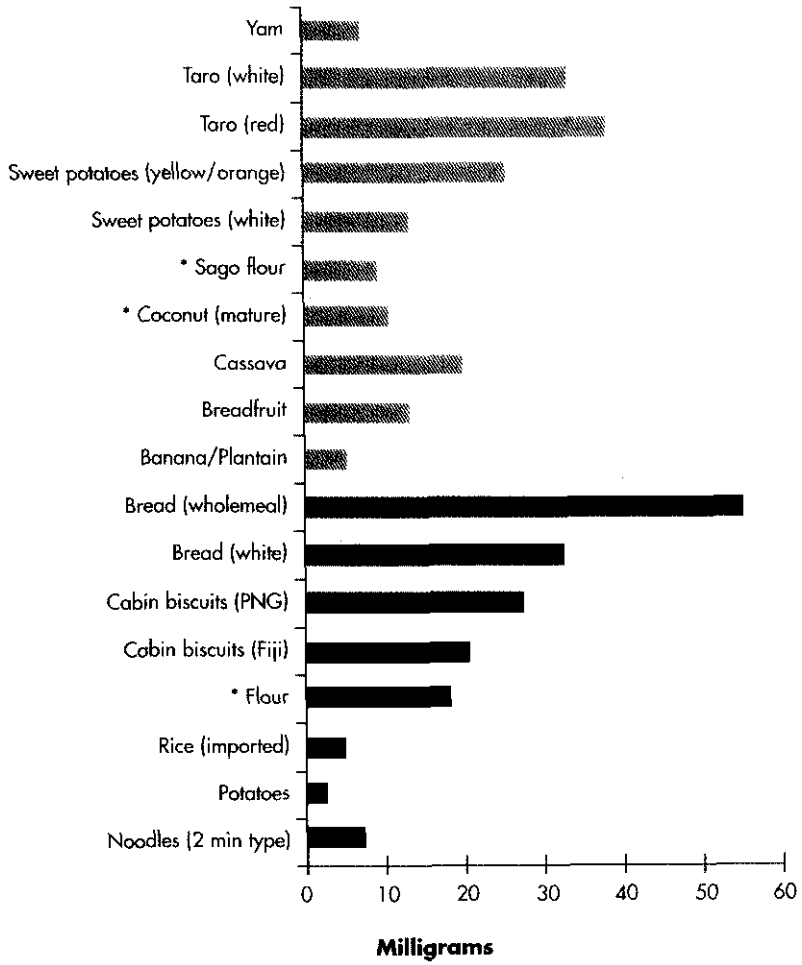

Figure 7: Calcium content (milligrams/100 grams) of cooked food

■ Local foods
■ Imported

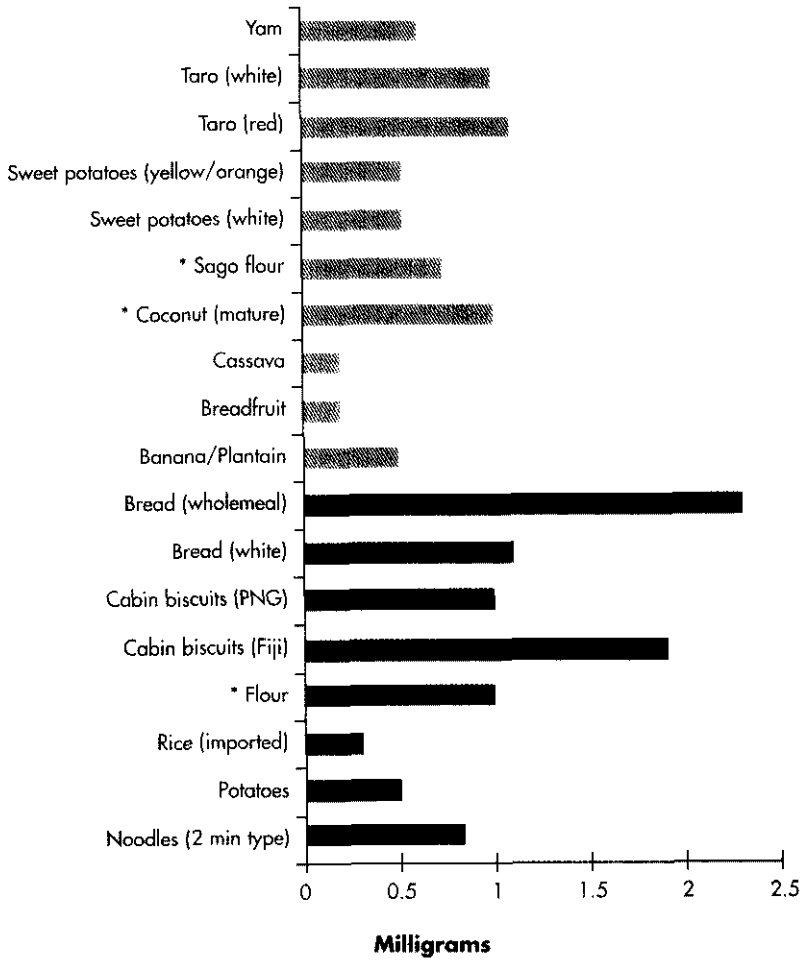

Figure 8: Iron content (milligrams/100 grams) of cooked food

▒ Local foods
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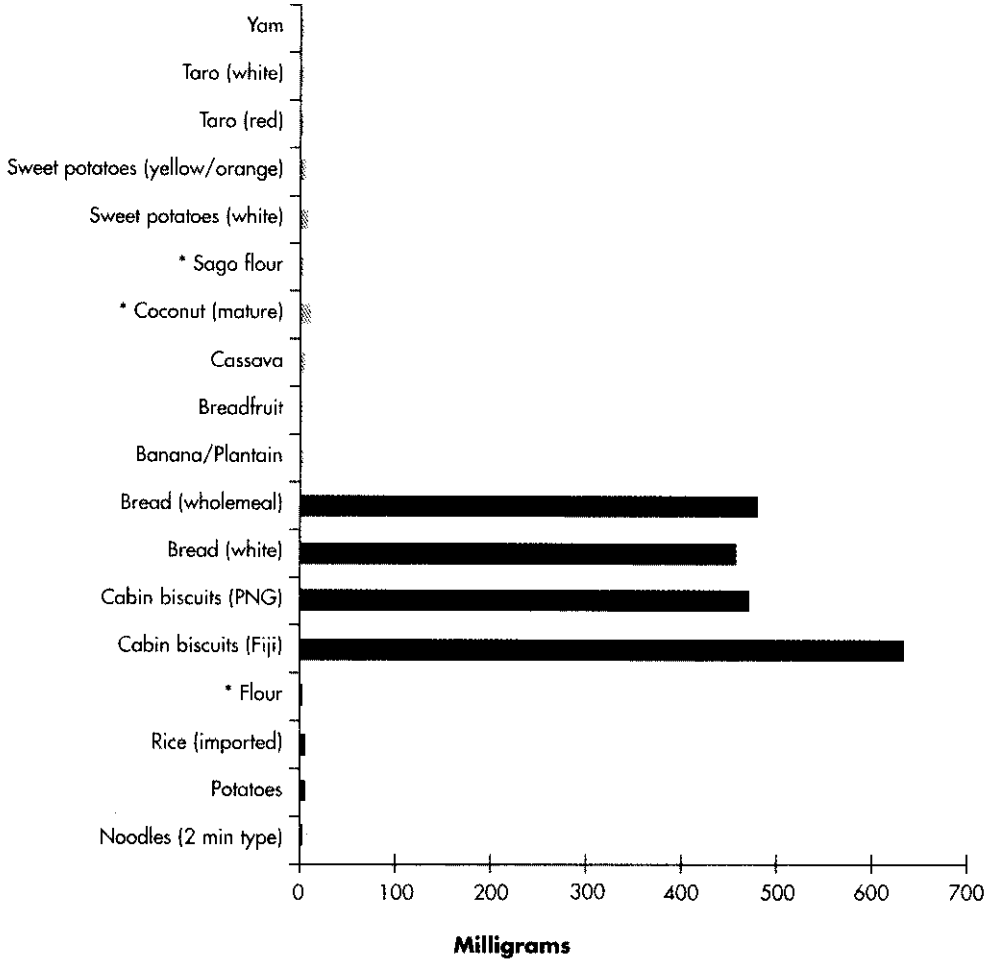

Figure 9: Sodium content (milligrams/100 grams) of cooked food

▒ Local foods
■ Imported

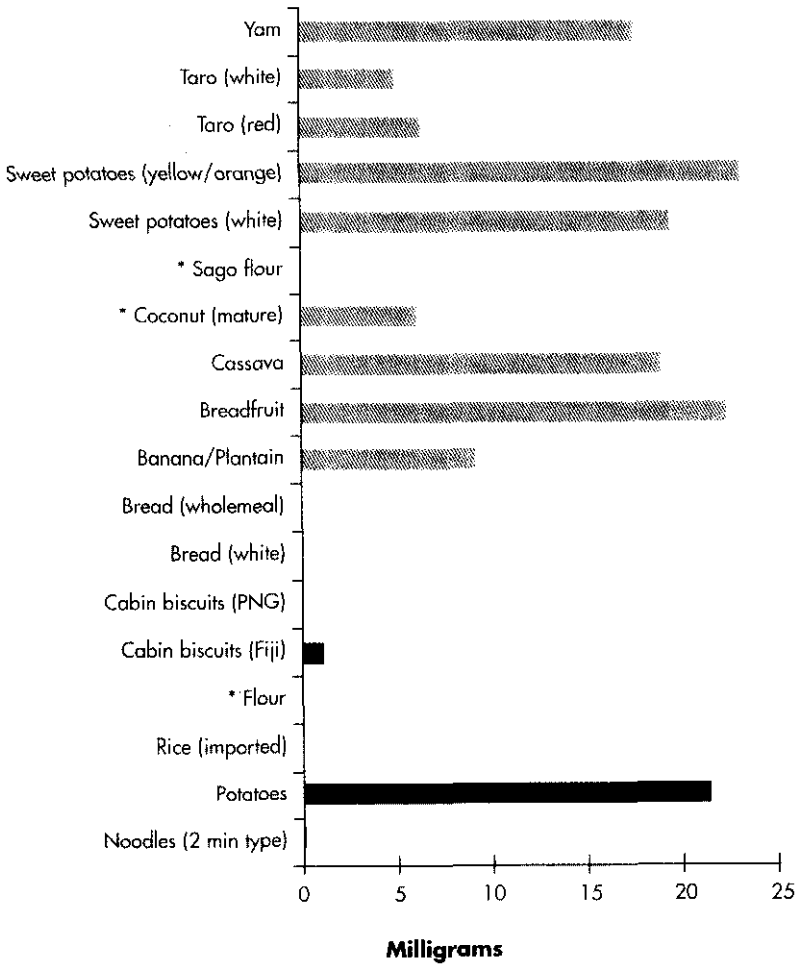

Figure 10: Vitamin C content (milligrams/100 grams) of cooked food

▒ Local foods

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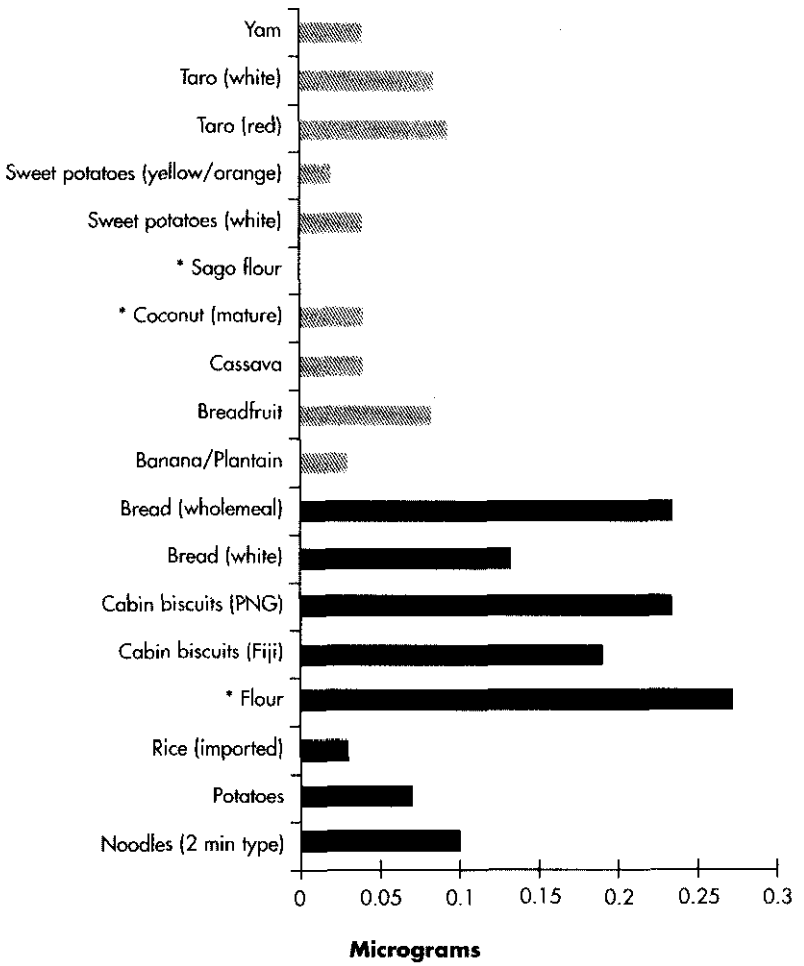

Figure 11: Thiamin (B1) content (micrograms/100 grams) of cooked food

▒ Local foods
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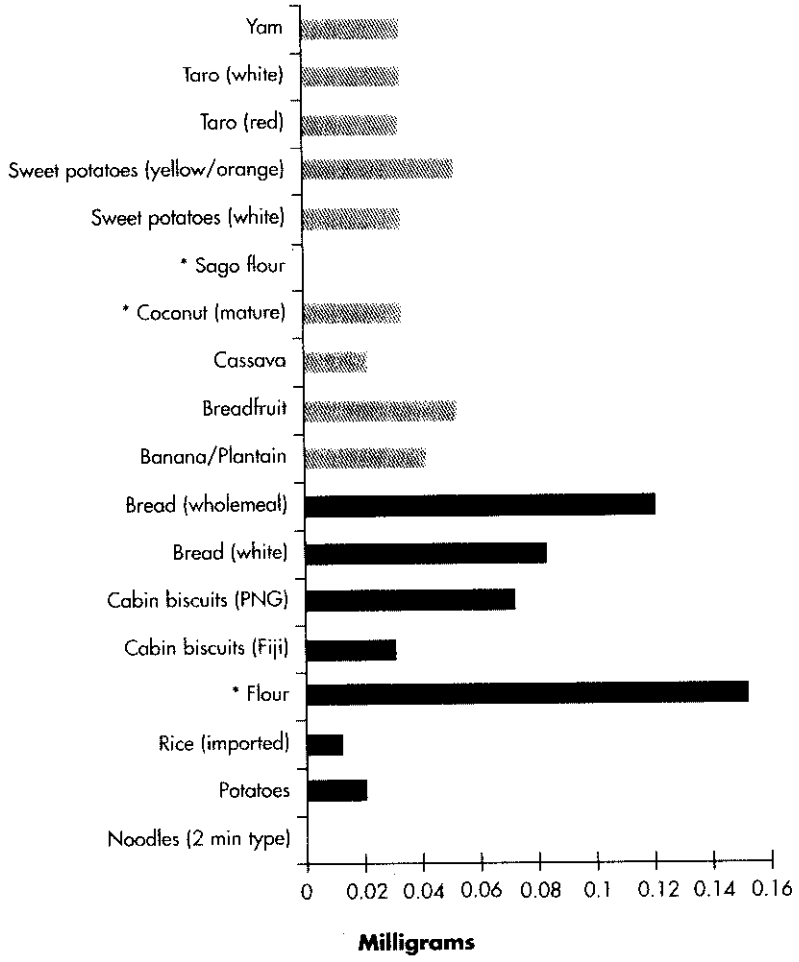

Figure 12: Riboflavin (B2) content (milligrams/100 grams) of cooked food

▒ Local foods
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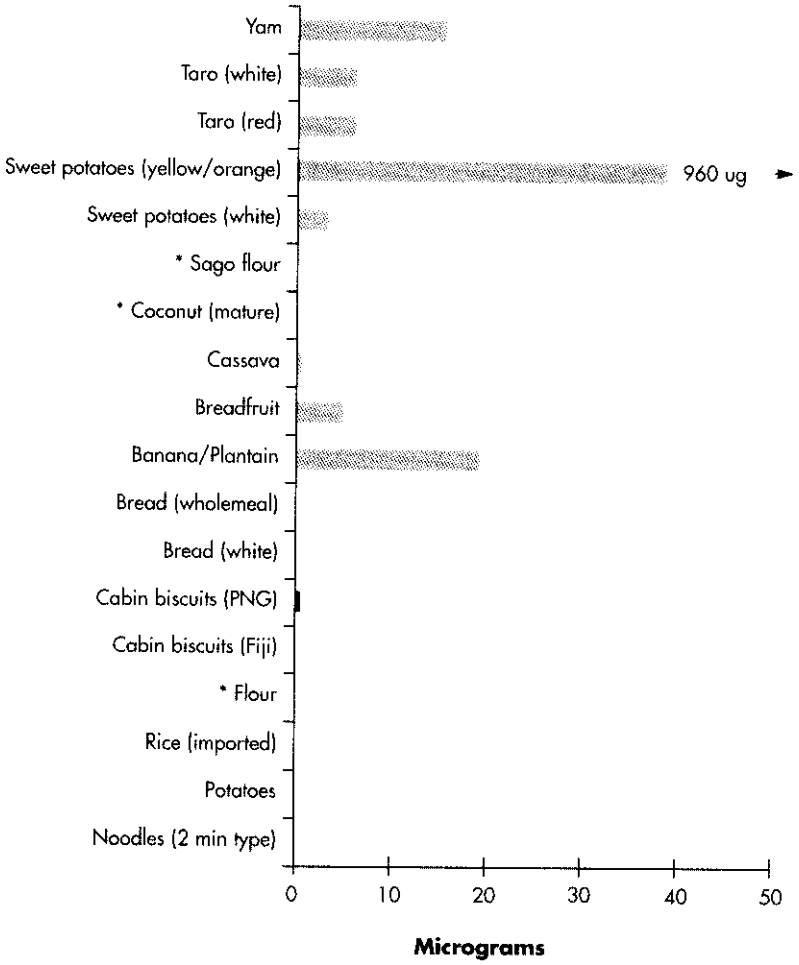

Figure 13: Vitamin A content (micrograms/100 grams) of cooked food

▒ Local foods
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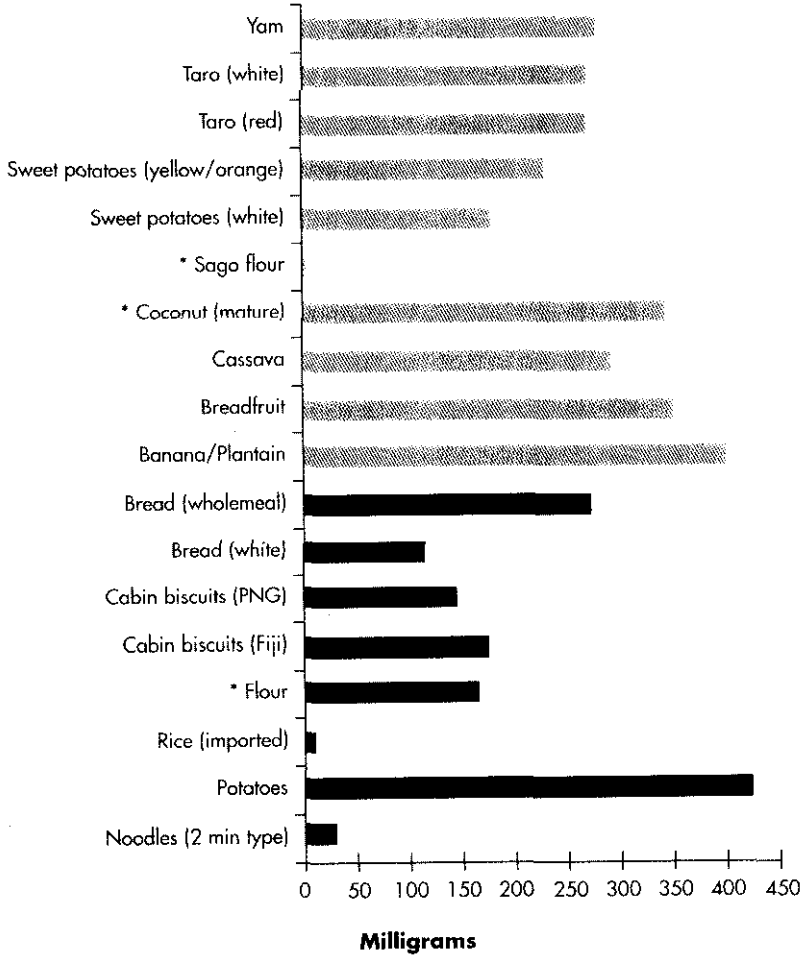

Figure 14: Potassium content (milligrams/100 grams) of cooked food

▒ Local foods
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Appendix 2

ANALYTICAL METHODS

Technical information on the food tables

The presentation of the nutrient composition data in this handbook is based on the format used in the 1994 edition of the *The Pacific Islands Food Composition Tables* and the guidelines developed by Greenfield and Southgate and commissioned by the International Network of Food Data Systems.

Notes on nutrients

There are values for 20 nutrients, dietary fibre, energy as kilojoules (kJ) and kilocalories (kcal) and cholesterol reported in the nutrient tables in this publication. The values published in this booklet are all analytical values determined in the Food Laboratory at the Institute of Applied Sciences at USP.

Proximates

The proximates reported in this publication are the following food components:

- Water
- Protein, calculated from the nitrogen determination
- Fat
- Carbohydrate, available – calculated from sugars and starch components
- Dietary fibre
- Cholesterol

Protein was calculated from the total nitrogen values by using the factor of 6.25.

Fat values refer to total lipid (from fat sources in the food), triglycerides, phospholipids, fatty acid derivatives and related compounds.

Carbohydrates are the total of the values analysed for the sugars glucose, fructose, sucrose, maltose and lactose and starch.

Dietary fibre values include resistant starch and substances measured as lignin.

Energy values have been calculated from the amounts of protein, fat, carbohydrate and alcohol in the foods. The factors used to estimate energy values are as follows:

Nutrient	kJ/g
• Protein	17
• Total fat	37
• Mono-, di-saccharides	16
• Starch	17

The kilocalorie (kcal) energy value was calculated by dividing the kilojoule (kJ) value by a factor of 4.184 (Greenfield and Southgate).

Inorganic constituents

The values for sodium, potassium, calcium, iron, magnesium, zinc, copper and manganese, determined by atomic absorption spectrophotometry, are included in the tables.

Vitamins

The vitamins reported in this publication include thiamin, riboflavin, niacin, total Vitamin A equivalents, retinol, beta-carotene equivalents and Vitamin C.

Vitamin A

Values are presented as total Vitamin A equivalents which are calculated as the sum of retinol and 1/6th the beta-carotene equivalents value. The beta-carotene equivalents value is calculated as the sum of beta-carotene and 1/2 the sum of the other measured pro-Vitamin A carotenoids.

Acknowledgements

This publication was produced by the Nutrition & Lifestyle Diseases Section of the Secretariat of the Pacific Community. It would not have been possible were it not for the assistance of Mele Malolo, who put together the first draft, and Tai'ora Matenga-Smith, who spent considerable time getting all the material together. Many other people around the Pacific had some input. Special mention is due to Professor Bill Aalbersberg and Dr Randy Thaman of the University of the South Pacific; Mrs Susan Parkinson of the Fiji Food and Nutrition Committee; Ms Mele Diligovou, Chief Nutritionist of the Fiji Ministry of Health; Ms Lois Engleberger, UNICEF Nutritionist in the Federated States of Micronesia; Dr Malcolm Hazelman, SPC Agriculture Manager; Ms Jane Paterson, Health and Nutrition Officer, UNICEF, Suva; Dr Ruth English, Nutrition Consultant and Dr Shawn Somerset, Queensland Government Laboratories, Australia; Mr Deveni Temu, SPC Librarian; and all Pacific nutritionists. Additionally, many thanks to all those tireless workers in SPC's Publications Section who edited, corrected and advised continually until publication day.

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Our thanks also to R.J. May, who gave us kind permission to reproduce photographs from his 1984 publication, *Kaikai Aniani*.

Not all foods are for eating!

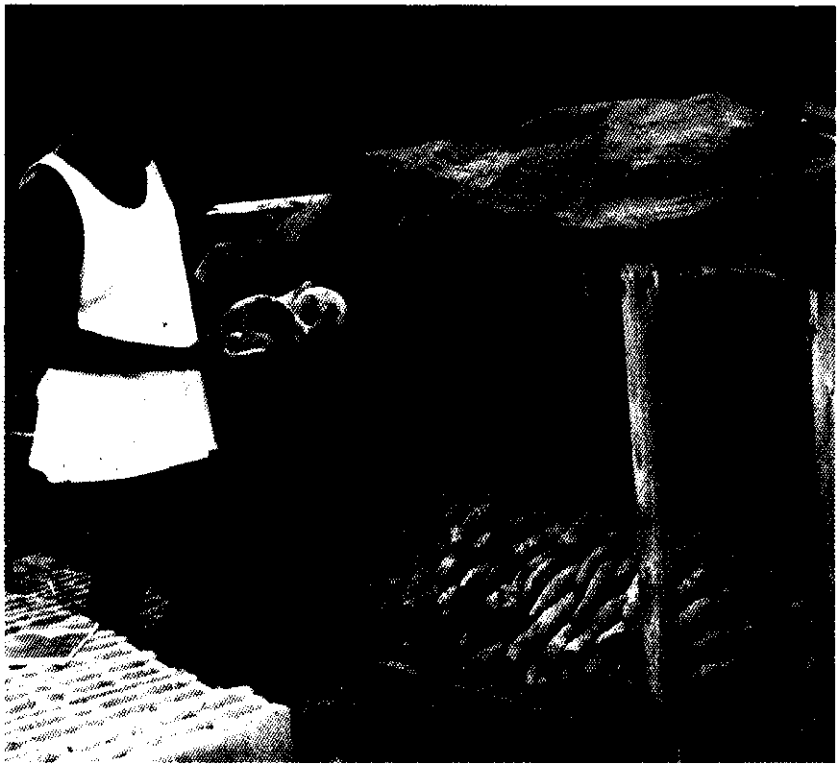

Photo: courtesy of Tour de Côte.