

**Tropical Foods:  
Chemistry  
and Nutrition**

**Volume 1**

**Edited by**

**George E. Inglett  
George Charalambous**

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Chemistry and Nutrition  
Volume 1

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# TROPICAL FOODS: CHEMISTRY AND NUTRITION

## Volume 1

*edited by*

**GEORGE E. INGLETT**

*U.S. Department of Agriculture  
Science and Education Administration  
Northern Regional Research Center  
Peoria, Illinois*

**GEORGE CHARALAMBOUS**

*Anheuser Busch, Inc.  
Technical Center  
St. Louis, Missouri*



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# Contributors

*Numbers in parentheses indicate the pages on which authors' contributions begin.*

- Alvarado y Sosa, L.* (69), Departamento de Industrias Agrícolas, Universidad Autónoma de Chapingo, Chapingo, Mexico
- Berry, Robert E.* (95, 111, 125), U.S. Citrus and Subtropical Products Laboratory, Winter Haven, Florida 33880
- Betschart, A. A.* (191), Western Regional Research Center, Science and Education Administration, U.S.D.A., Berkeley, California 94710
- Brewster, Linda C.* (155), Fruit and Vegetable Chemistry Laboratory, Science and Education Administration, U.S.D.A., Pasadena, California 91106
- Casier, J. P. J.* (279), Katholieke Universiteit Leuven, 36 Prinses Lydiaalaan, 3030 Heverlee, Belgium
- Cavaletto, Catherine G.* (25), Department of Food Science and Technology, University of Hawaii, Honolulu, Hawaii 96844
- Chan, Harvey T., Jr.* (33), Commodity Treatment, Handling, and Distribution Unit, Science and Education Administration, U.S.D.A., Hilo, Hawaii 96720
- Coleman, Richard L.* (111), U.S. Citrus and Subtropical Products Laboratory, Winter Haven, Florida 33880
- De Paepe, G. M. J.* (279), Katholieke Universiteit Leuven, 36 Prinses Lydiaalaan, 3030 Heverlee, Belgium
- Deyoe, Charles W.* (217), Department of Grain Science and Industry, Kansas State University, Manhattan, Kansas 66502
- Goffings, G. J. G.* (279), Katholieke Universiteit Leuven, 36 Prinses Lydiaalaan, 3030 Heverlee, Belgium
- Hermans, J. L.* (279), Katholieke Universiteit Leuven, 36 Prinses Lydiaalaan, 3030 Heverlee, Belgium
- Lakshminarayana, S.* (69), Departamento de Biotecnología, Universidad Autónoma Metropolitana, Iztapalapa, Mexico



- Lime, Bruce J.* (171), Food Crops Utilization Laboratory, U.S.D.A., Weslaco, Texas 78596
- Maier, V. P.* (155), Fruit and Vegetable Chemistry Laboratory, Science and Education Administration, U.S.D.A., Pasadena, California 91106
- Mannheim, Chaim H.* (141), Department of Food Engineering and Biotechnology, Technion—Israel Institute of Technology, Haifa, Israel
- Martin, Franklin W.* (249), Mayagüez Institute of Tropical Agriculture, Science and Education Administration, U.S.D.A., Mayagüez, Puerto Rico 00708
- Noppen, H. E.* (279), Katholieke Universiteit Leuven, 36 Prinses Lydialaan, 3030 Heverlee, Belgium
- Norman, Shirley M.* (155), Fruit and Vegetable Chemistry Laboratory, Science and Education Administration, U.S.D.A., Pasadena, California 91106
- Passy, Nehama* (141), Department of Food Engineering and Biotechnology, Technion—Israel Institute of Technology, Haifa, Israel
- Perez, F. Barrientos* (69), Rama de Genetica, Colegio de Postgraduados, Chapingo, Mexico
- Robinson, Robert J.* (217), Department of Grain Science and Industry, Kansas State University, Manhattan, Kansas 66502
- Sakai, William S.* (265), College of Agriculture, University of Hawaii at Hilo, Hilo, Hawaii 96720
- Saunders, R. M.* (191), Western Regional Research Center, Science and Education Administration, U.S.D.A., Berkeley, California 94710
- Standal, Bluebell R.* (1), Department of Food and Nutritional Sciences, University of Hawaii, Honolulu, Hawaii 96844
- Tang, Chung-Shih* (33, 55), Department of Agricultural Biochemistry, University of Hawaii, Honolulu, Hawaii 96844
- Tsen, Cho C.* (239), Department of Grain Science and Industry, Kansas State University, Manhattan, Kansas 66502
- Tu, C. C.* (185), Department of Food Science and Technology, University of Hawaii, Honolulu, Hawaii 96844
- Wagner, Charles J., Jr.* (111), U.S. Citrus and Subtropical Products Laboratory, Winter Haven, Florida 33880
- Willems, H. E. J.* (279), Katholieke Universiteit Leuven, 36 Prinses Lydialaan, 3030 Heverlee, Belgium
- Wilson, Charles W. III* (111), U.S. Citrus and Subtropical Products Laboratory, Winter Haven, Florida 33880
- Yokoyama, Henry* (155), Fruit and Vegetable Chemistry Laboratory, Science and Education Administration, U.S.D.A., Pasadena, California 91106

## *Preface*

This volume is the first of a two volume treatise on tropical foods. Both volumes contain papers representing the proceedings of an international conference on Tropical Foods: Chemistry and Nutrition held in Honolulu, Hawaii, March 28–30, 1979. Recent progress on the chemistry and nutrition of tropical foods are covered in these volumes.

Tropical foods are widely grown and consumed in many parts of the world. Many tropical foods are exported while many others offer considerable promise for future development. Some of these foods appear to have opportunities for improving product lines or creating new products.

Both volumes are valuable books for scientists, technologists, executives, students and all other concerned with cultivating, processing, manufacturing, research, development, or marketing of foods.

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TROPICAL FOODS OF THE PACIFIC REGION

Bluebell R. Standal

Department of Food and Nutritional Sciences  
University of Hawaii  
Honolulu, Hawaii

South Pacific nutritionists classify foods as those that provide energy for the body (Group I), those that predominantly provide amino acids for synthesis of tissue proteins for growth and repair (Group II), and those that provide nutrients that become involved in numerous biological reactions for optimal maintenance of nutritional balance and health (Group III). At present, the food supply in the Pacific region is a combination of foods that are harvested in the region and those that are imported. The importation of food is on the increase amounting to 20 to 30% of total import cost of all goods. This discussion deals mainly with foods that are harvested in the region.

I. FOODS FOR CALORIES: ENERGY FOODS

Energy foods are predominantly carbohydrates or fats but other nutrients may accompany these.

A. Carbohydrate Foods

Carbohydrate foods include edible aroids, yams, sweet potatoes, cassava, arrowroot, green bananas, breadfruit, sago, cereals and sugar plants. A limited amount of rice is

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grown in Papua New Guinea, but the majority is imported. Since imported rice, sugar, and wheat flour are highly refined and since carbohydrate consumption is high, the use of locally grown carbohydrate foods should continue and be actively encouraged due to other nutrients in them.

1. Edible Aroids (Araceae). The common name "taro" is used for corms and cormels of edible aroids, but each variety has its own local name. The leaves and corms contain varying quantities of raphides (oxalate crystals), which are primarily responsible for the irritating sensation to the gums and mucous membrane of the mouth. Edible aroids have lesser amounts of raphides but even so proper cooking is necessary. People of the Pacific region are well versed in the preparation and cooking of each type of taro to eliminate the irritation and other dangers of eating improperly prepared taro. In general, only the corms and cormels are eaten and they may be boiled, baked in underground or kitchen ovens, sliced thin and fried into chips, or steamed and pounded into a thick paste. In Hawaii, the paste is called "poi" and may be eaten freshly prepared or partially fermented. In the family Araceae, the genera Alocasia, Colocasia, Cyrtosperma, and Xanthosoma are important starch-producing plants of the Pacific region. Taro, a major staple food, is unfortunately low in protein content, 2 to 5% by weight. Recognizing the nutritional and economical importance of staple foods with higher protein content, plant breeders in the Pacific region are actively conducting research to increase the protein content of certain varieties of taro.

a. Alocasia macrorrhiza. This is the most common taro and it is known as "oht" in Ponape, "ape" in Tahiti, "kape" in the Cook Islands, "wave" or "pindu" in New Caledonia, "viagaga" or "viamila" in Fiji, and "toamu" in Samoa (1). The corms may be 0.5 to 1 m in length and may weigh 20 kg or more and are important secondary staple foods in the Kingdom of Tonga, Western Samoa, New Hebrides, and Micronesia.

b. Colocasia esculenta. This variety is generally known as "taro" and "dasheen." It grows widely all over the Pacific region in the tropical and subtropical areas. Both wet and dryland types are grown and are used for food. In Hawaii, the dryland taro is used for table taro and the wetland taro for making poi. Among the aroids, the leaves and stems of Colocasia esculenta are the only ones that are used for food. The leaves and stems are prepared by boiling and are often called spinach.

c. Cyrtosperma chamissonis. The corms of this variety may reach 40 to 80 kg in weight which may account for its name "giant swamp taro." In the Yap district it is called the "king" of taros (2). It can grow successfully under limited amounts of soil as long as the roots are wrapped with leaves or baskets to contain the moisture. For this reason it is known as "taro of the atolls." It will grow for several decades and produce taro and it is known as "babai" in the Gilbert Islands, "muhang" in Ponape, "viakana" on Viti Levu, "moata" in Tahiti, and "pulaka" or "puraka" in the Cook Islands, Tokelau, and Samoa (1). Cyrtosperma taro is replacing the Colocasia variety in the Trust Territories since Colocasia is more susceptible to disease and insect pests.

d. Xanthosoma sagittifolium. This variety of aroid is more resistant to disease and requires less moisture than Colocasia esculenta. Thus, it is rapidly expanding in the tropics. The cormels are usually harvested for food since the main corm is too acrid. It is known as "tania," however, it is also known as "kong king taro" in New Guinea, "New Hebrides taro" in New Caledonia, "Fiji taro" in New Hebrides, "taro papalagi" in Samoa, "Saipan (meaning from Japan) taro" in Truk, "tarua" in Tahiti, "dalo ditana" in Fiji, and "sawah-n-awai" in Ponape (1). It is prepared by peeling and boiling in plain water or it can be peeled, chopped into small pieces, and cooked in coconut milk. Sometimes it is peeled, scalded, then chopped into smaller pieces and dried in the sun, and after it is fully dried, stored in cans for a month or two (2).

e. Amorphophallus campanulatus. The common name of this variety is "elephant foot." Among the aroids this variety is the least important one for food (1). The variety 'Konjac' is used for making "konnyaku" flour, which is used in Japanese dishes (3). The major carbohydrate of konnyaku is mannan, and it is not metabolized by man (4).

2. Yam (Dioscoreaceae). The six main species of yams in the Pacific islands are Dioscorea alata, D. bulbifera, D. esculenta, D. pentaphylla, D. hispida and D. nummularia (1). These are indigeneous to the Indo-Pacific region and are basic staple foods. The tubers and bulbils are eaten but never the leaves or shoots. In the tradition of the Melanesians, yams and taros are important objects in their age-old rituals, where the yam plant, grown in dryland is male, and taro plant, grown in wetland is female (5). Yam plays an important role in Ponape due to its high ceremonial status in traditional island feasts. The size, age, quantity

of yams, and the frequency of contribution of these to the traditional feasts determine how fast a person can move up the ladder of the Ponapean title system (2). Yam growers in Ponape are possessive of their secret methods of growing this highly esteemed crop.

Some varieties of perennial yam grow to gigantic sizes in Ponape, and several people are required to carry a single piece of tuber. In Ponape, the size of a yam is known as a 2-man, 4-man, or 6-man yam, which describes the number of men needed to carry the yam pieces. A single 6-man yam tuber can weigh up to 600 pounds (270 kg) and a long variety of yam tuber grown on hillsides may be 6 feet (1.8 m) long and about a foot (0.3 m) in diameter (2). Usually the average annual variety of yam weighs 15 to 20 pounds (6.8 to 9 kg) and is the most common size of yam in the islands of Mariana and Yap.

The most common method of cooking yams is by boiling, however, steaming in an underground rock oven is an alternate way. Yams can be peeled and cut into smaller chunks and cooked in coconut milk together with fish, chicken, pork, or beef. For Christmas and New Year feasts, a type of doughnut called "bonelos" is traditionally prepared by the Chamorros of the Mariana Islands. Peeled and grated yams are mixed with flour and deep fat fried until brown and then dipped in honey or syrup. Yams can be stored for several months to a year if kept in cool, dry, dark, and well-ventilated place (2).

3. Sweet potatoes (Ipomoea). Many varieties of sweet potatoes are grown, with purple or tan outside skin and with white, orange, or purple meat. The orange-meat variety is favored by nutritionists because of its higher carotene content. A variety 'Okinawa' was introduced into New Guinea by the Japanese army during World War II. Sweet potato is an important food in Papua New Guinea, and among the Melanesians and Polynesians it is known as "kumara." If washed and dried in the sun and stored in cool, airy place, sweet potatoes will last for several months.

4. Cassava (Manihot). Cassava growing is on the increase in all Pacific islands, chiefly in Fiji, Palau, and New Caledonia, and is used as staple food. The roots of the sweet variety (Manihot dulcis, M. palmara) contain less cyanide than of the bitter one (Manihot esculenta, M. utilissima). The young leaves contain 6 to 10% of methionine-rich protein (3) and are used as vegetables that must be prepared with appropriate care to remove most of the cyanide. In the Mariana Islands, a white tuber variety of cassava is made into tapioca starch and is used by the Chamorros mainly

for making biscuits called "roskete" (2). The variety with a yellow tuber is suitable for a preparation similar to American pudding (2).

5. Arrowroot (*Tacca leontopetaloides*). Polynesian arrowroot is known as "mokmok" in Marshall Islands, where it is still a major root crop, although not much care is given in its cultivation (2). Arrowroot is found growing in wild condition on almost all the islands of Micronesia but is not considered an economically important crop or staple food. The tubers contain a bitter substance that disappears with washing or cooking.

Arrowroot starch is prepared by grating the tubers and washing the grated parts several times with fresh or sea water in order to remove the bitter acid. The starch is then allowed to settle in water and the grated material is discarded. The starch is washed twice, wrapped in a cloth, and allowed to drain. It is then dried in the sun, made into fine powder, and stored in glass containers such as large jars that are covered tightly and securely (2).

In Tahiti, the arrowroot starch is used for making "poe" ("poke" in the Cook Islands) which is a traditional food and consists of a mixture of fruit pulp (papaya, banana, pumpkin, etc.) and starch in various proportions. This is flavored with vanilla and lemon, wrapped in green leaves, and cooked in the native oven. It is eaten sprinkled with coconut cream. In Samoa, where arrowroot starch is called "masoa," it is cooked either in an oven after being mixed with coconut cream and wrapped in leaves ("faiai vatia") or it is made into "poe" called "piasua," or into a porridge called "vaisalo," which is a combination of the starch and coconut water (1). Today cassava starch is taking the place of arrowroot for preparing "poe."

6. Bananas (*Musa*). Green bananas are used as a staple but the ripe bananas are considered food for the elderly or for sick persons. Green bananas are peeled and boiled or are boiled in their skins and used like boiled potatoes with meats and sauces. There is no sweet taste to boiled green bananas.

7. Breadfruit (*Artocarpus*). The fruits of the breadfruit tree (*Artocarpus communis*) are green when matured and are about 15 cm long and 10 to 12 cm wide. The fruit may be boiled, cooked in stews, baked in an oven, or roasted with hot stones in an underground pit called "imu" in Hawaii and "umu" in Samoa. When baked, breadfruit meat becomes pale yellow and bears a resemblance to a fluffy sweet potato in color, texture, and taste.



Sometimes boiled breadfruits are pounded into a mass and mixed with banana and eaten with coconut milk. At other times, peeled breadfruits are sliced thin and fried in deep fat for chips.

For storage, the fruits are sliced and dried in the sun or in an oven. Another method is to cook the fruit then mash it to a paste, dry it in the sun in thin layers, and store it wrapped in plaited banana or "ti" (*Cordyline terminalis*) leaves. A simple process of preserving breadfruit by fermentation is used in Polynesia and Micronesia, where a great quantity of fruit is cooked in a large native oven, left there to ferment, and the product is removed as needed through an opening on the side of the oven (1). This method provides preservation for a few weeks. For longer preservation, the ripe fruit is peeled, washed, cut in halves and placed in a stone pit lined with "ti" leaves. Layers of fresh fruit are alternated with layers of old fermented preparation in order to facilitate fermentation and to obtain a more homogeneous product. When the pit is full, it is covered with leaves, rocks, and earth, and portions are removed as needed. At the next harvest, a pit that has not been completely emptied will simply be filled up again. Fermentation is a highly effective way to preserve the paste, which will keep for months or even years (1). Nutrient composition of fermented paste is unavailable, but the popularity of the product merits that nutrient composition be known.

To Westerners, the breadfruit tree is a symbol of romance of the South Seas. Books, films, and travelogs have popularized the fruit and related it to a lifestyle of easy living, comfort, abundance, and romance.

A relative of breadfruit is jackfruit (*Artocarpus integra*) which is about 20 to 25 cm long and 15 to 20 cm wide. The unripe fruit is used in soups, sauces, and curries. Young leaves, shoots, and flowers are used as vegetables. The ripe fruits are sweet, and contain seeds that are about 4 cm long and 2 cm wide. The seeds may be boiled or roasted, are mildly sweet, and contain around 8% protein.

8. Sago. The trunk of the sago palm (*Mextroxylon sagu*) is very rich in starch. The bark of cut trunks is partially removed and the inner stem is pounded to extract the starch. In New Guinea, the sago starch is kept moist and slightly fermented (5). Sago may be boiled and mixed into a paste with grated coconuts, legumes, spices, meat or fish. Sago is a basic food of coastal people, and in Solomon Islands and Tonga, sago is a reserved food (5).

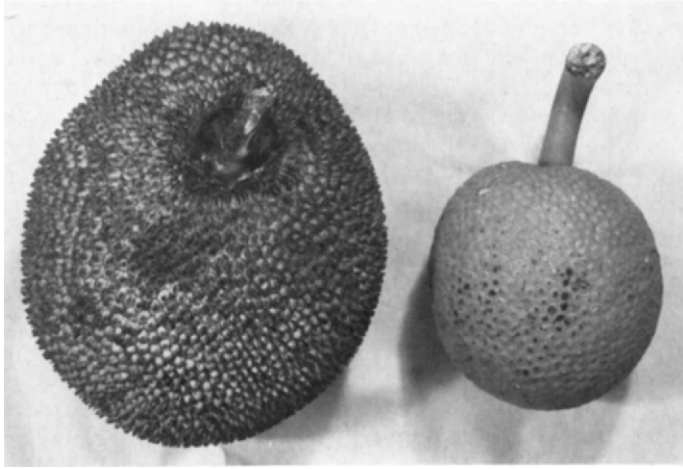
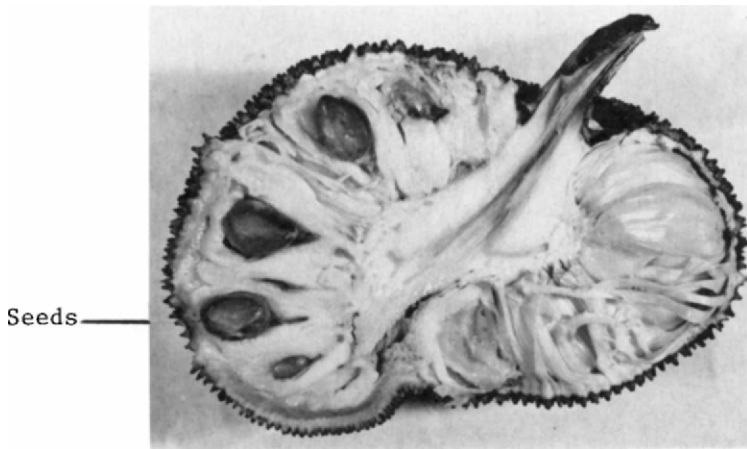


FIGURE 1. Jackfruit

Breadfruit



Seeds

FIGURE 2. Cut Jackfruit