

## UTILIZATION POTENTIAL FOR SEMI-TROPICAL AND TROPICAL FRUITS AND VEGETABLES IN THERAPEUTIC AND FAMILY DIETS

JANELL SMITH, SEYMOUR GOLDWEBER, MARY LAMBERTS,  
RICHARD TYSON, AND J. S. REYNOLDS  
University of Florida, IFAS,  
Dade County Cooperative Extension,  
18710 SW 288th St.,  
Homestead, FL 33030

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**Abstract.** Many types of tropical and sub-tropical fruits and vegetables are marketed through commercial channels as well as being found in dooryard plantings in South Florida. Most have not been recognized as playing an important role in providing essential nutrients for good health. Nutritional values are discussed together with their potential application in low salt, low fat, high potassium and high fiber diets. Special emphasis is given to avocado, calabaza, cassava, chayote, lime, malanga, mango, papaya, and taro.

It has long been recognized that fruits and vegetables are important in overall good nutrition. The role of tropical fruits and vegetables in nutrition is less well known. This paper reviews tropical fruits and vegetables grown commercially in South Florida and other areas of the semi-tropics and tropics. A brief overview of nutrient quality and composition of these fruits and vegetables is included. In addition, an analysis of the potential use of tropical fruits and vegetables in controlled fiber, fat, sodium and calorie diets, as well as in diets for normal human nutrition is discussed.

Among the more than 200 kinds of tropical fruit crops grown in Dade County, this paper examines nutritional values of avocados, bananas, carambolas, guavas, 'Tahiti' and 'Key' limes, lychees, longans, mameys, papayas, Atemoyas, and sugar apples. The tropical vegetables boniato, calabaza, cassava, chayote, malanga, pigeon pea, and taro are also included.

The USDA Basic Four Food Plan recommends 4 servings per day of fruits and vegetables for healthy adults. Fruits and vegetables make major contributions of vitamins A and C, folic acid, micronutrients, and fiber to the diet. In general, fruits and vegetables are low in both fat and sodium.

### Tropical Fruit Crops

Dade County avocado (*Persea americana* Mill.) cultivars, chiefly West Indian and West Indian x Guatemalan hybrids, are planted on ca. 4,280 ha of limestone soil. Harvest season extends from late June through February. The earliest cultivars are West Indian with mid-season and late cultivars of the West Indian x Guatemalan hybrids. There are more than 400 ha planted in other South Florida counties.

Commercial banana (*Musa* spp.) production beginning in the late 1960's consists mainly of the apple (manzana) for local markets, with some intra- and interstate shipments. Approximately 140 ha of this fruit is produced, plus a small acreage of plantains (for local markets).

Carambolas (star fruit) (*Averrhoa carambola* L.), a new and expanding tree crop from Southeast Asia, are planted

on some 20 ha. Fruit is marketed as a fresh commodity with some fruit processed on a small scale.

Once a promising New World commercial crop for Dade County, guavas (*Psidium guajava* L.) are now being planted again despite Caribbean fruit fly problems. There are roughly 36 ha of red and white hybrids. This crop is highly suitable for marginal wet lands.

'Tahiti' ('Persian') limes (*Citrus latifolia* Tan.), 2920 ha, make Dade County the chief U.S. producer (90%) of this tropical acid citrus. The 'Key' lime (*Citrus aurantifolia* (Christm.) Swing.) is no longer produced commercially, but is still a popular dooryard fruit. This is a year-round crop, reaching its peak volume in June, July and August.

Lychee (*Litchi chinensis* Sonn.), a native of China, is planted on some 36 ha of Dade County limestone. The chief cultivar is the Brewster, a deep red, golf ball sized fruit with an off-white, sweet, spicy pulp. The season is from June through August, depending upon weather conditions during the winter blooming period.

Longan (*Euphoria longana* Lam.), another native of China, and prized by Orientals, is becoming highly popular as a crop to follow the fruiting period of the lychee. Cultivar selections thus far are mainly of the Kohala, which originated in Hawaii.

Mamey (*Calocarpum sapota* (Jacq.) Merr.), another fruit of the New World, is a rapidly expanding industry with an estimated 120 or more ha already planted to some 5 cultivars. This fruit commands a high market price, especially in local Latin American food markets. It is mainly used in milkshakes and ice cream.

Mangos (*Mangifera indica* L.), a native of India and second only to bananas in world fruit consumption, account for some 760 ha of Dade County soil, with an additional 120 or more ha planted outside the county. The season is from late May through August, with the peak of the season in June and July.

Papaya (pawpaw, fruta bomba, tree melon) (*Carica papaya* L.) is grown on ca. 200 ha in Dade County with a yield of roughly 34,000 kg/ha. This New World fruit is usually consumed fresh with some processed.

Atemoyas (sugar apple x cherimoya hybrid) (*Annona squamosa* L. x *A. cherimola* Mill.) and sugar apples (*A. squamosa* L.), planted on some 36 ha of limestone, are perhaps the most unusual looking of the tropical fruits discussed here. This New World fruit has a ready market wherever Latin Americans, West Indians or Southeast Asians reside in the U.S.

### Tropical Vegetables

Tropical root crops of economic importance in Dade County, Florida, are malanga (*Xanthosoma caracu* Koch and Bouché), boniato (*Ipomoea batatas* (L.) Lam.) and yuca or cassava (*Manihot esculenta* (L.) Crantz). Approximately 1080 ha of malanga, 2,000 ha of boniatos and 140 ha of yuca are harvested each year.

Malanga (yautia) is planted in the early spring in Dade County and requires about 8 months to mature. It has a central corm that is surrounded by cormels. These are potato-sized and are the marketable product (9). The taro or dasheen, a similar aroid, (*Colocasia esculenta* Schott) is grown on a limited basis since most of Dade County's trop-

ical vegetable growers are originally from the Caribbean, and market to consumers who prefer malanga.

Boniatos grown in Dade County are the traditional red-skinned, white-fleshed sweet potato of Cuba and other tropical countries (10). Planting material was introduced in the United States primarily by Cuban immigrants. Production occurs year round; cultivars are cool- and warm-season specific. Stem cuttings from the tips of mature plants are used for planting stock. Edible tubers are ready for harvest ca. 150 days after planting.

Yuca (cassava) is also planted in the early spring in Dade County. Edible tubers are ready for harvest ca. 9 months after planting. Stem cuttings 25-30 cm in length are used for planting material.

Three other tropical vegetable crops of commercial importance in Dade County, Florida are: calabaza (*Cucurbita moschata* Duch. ex Lam.), chayote (*Sechium edule* Sw.), and the pigeon pea (*Cajanus cajan* (L.) Millsp.). There are 300 ha of calabaza, 10 of chayote and 8 of pigeon pea.

Calabaza (Cuban pumpkin) is cultivated extensively in Mexico, Central and South America and in some of the West Indian Islands as well as tropical Asia. Fruits are round and weigh  $6.8 \pm 3.0$  kg; vines can be over 6 m in length. Dade County produces 4 crops per year. It is open pollinated and there is currently no commercial source of seed (14).

Chayote (vegetable pear) is the only perennial cucurbit. It is grown in Central America and on the Indian Subcontinent. Production in Dade County is year round, though highest yields are from October through June, with a peak in May. Chayote is grown on 2.5 m trellises. Mature fruits must be used for seed (4).

Pigeon peas are grown extensively as a pulse crop in India and in some parts of Africa. They are short-lived woody shrubs, reaching 1-4 m. Yields are highest from the first season, but in some situations reasonable yields can be maintained over 2 to 4 seasons (11).

### Food Composition of Tropical Fruits and Vegetables

#### Sodium and Potassium Components

High intake of sodium has been implicated in hyperten-

sion (high blood pressure), though the data are still under review since this effect has only been observed for a portion of the population at risk. Potassium, on the other hand, is frequently supplied in limited quantities and is readily lost by persons taking diuretics. For these reasons, a diet which contains low levels of sodium and high levels of potassium is encouraged (15).

Fruits and vegetables are naturally low in sodium and high in potassium, especially when compared to foods such as cured meats and cheeses. Tropical fruits and vegetables offer variety and interest to therapeutic meals, that is, physician-prescribed diets. For example, the Florida avocado contains 544 mg of potassium per 100 g, nearly twice the potassium contained in an average banana. Comparing the potassium content of other tropical fruits to that of bananas suggests other potential additions to therapeutic meal plans. Longans, papayas and sugar apples all contain more potassium than equal portions of bananas (Table 1).

The sodium content of mango, papaya and carambola is less than 2.5 mg per 100 g serving, which is comparable to that of pears or bananas.

Tropical vegetables also can make significant contributions to therapeutic meals. Plantains, included here because of the way they are prepared as a starch, are strong sources of potassium offering 448 mg and only 4 mg of sodium. Plantains can be substituted for other carbohydrates. Taro offers 50% more potassium per serving than Irish potatoes, 499 mg vs. 305 mg, respectively. The chayote has potassium values similar to fresh summer squash and could be substituted in many recipes (108 mg vs. 125 mg per 100 g serving). The calabaza squash is also worth examining for its potassium level which is similar to that of carrots (351 mg for calabaza and 341 mg for carrots). While the calabaza and carrots compare favorably in potassium content, calabaza has only 7 mg of sodium, where an equivalent amount of carrots contains 47 mg (Table 2).

#### Fiber

Food fiber varies according to the plant part (whether it is a stem, root, flower, seed, fruit, or leaf) and the maturity

Table 1. Selected nutrient composition of 100 g portions of common and tropical fruits.<sup>a</sup>

	Approx. home measurement	Potassium (mg)	Sodium (mg)	Cal.	Fiber		Vitamins	
					soluble (g)	insoluble (g)	C (mg)	A (I.U.)
<b>Common fruits</b>								
Apple, with peel	2/3 average	110	1.5	57	0.54	2.27	5.7	53
Banana	1 small average	251	1.8	92	0.50	1.40	9.1	81
Grapes	25 grapes	174	4.0	71	0.45	1.65	10.8	73
Orange, Florida	1/2 average	130	6.0	46	0.34	n.a. <sup>b</sup>	45.0	200
Pear	2/3 average	109	2.0	59	1.40	2.46	4.0	20
Peach	1 small	202	1.0	43	0.64	0.62	6.6	535
<b>Tropical fruits</b>								
Avocado, California	2/3 cup (1 inch cubes)	544	6.0	177	2.11	2.70	7.9	612
Florida	2/3 cup (1 inch cubes)	544	6.0	112	2.11	2.70	7.9	612
Carambola	1/2 cup (slices)	164	1.5	33	0.92	1.15	21.2	493
Guava, red	1/3 cup (pieces)	289	4.0	51	5.60	n.a.	183.5	792
Lime, fresh juice	1/3 cup	n.a.	0.0	27	0.21	n.a.	29.3	10
Longan	10 or 1/2 cup	266	0.0	60	0.40	n.a.	84.0	n.a.
Lychee	10 or 1/2 cup	170	3.0	66	0.21	n.a.	71.5	n.a.
Mamey	2/3 cup (1/2 inch cubes)	47	15.0	51	1.00	n.a.	14.0	230
Mango	2/3 cup (1/2 inch cubes)	156	2.0	65	0.84	1.08	27.7	3894
Papaya	2/3 cup (1/2 inch cubes)	221	2.3	39	0.77	0.91	61.8	2014
Sugar apple	1/3 cup	299	5.0	94	0.78	n.a.	36.3	6

<sup>a</sup>Source of information see refs. 1, 3, 6, 7, 8, 12, 17.

<sup>b</sup>n.a. = not available.

Table 2. Selected nutrient composition of 100 g portions of common and tropical vegetables.\*

	Approx. home measurement	Potassium (mg)	Sodium (mg)	Cal.	Fiber		Vitamins	
					soluble (g)	insoluble (g)	C (mg)	A (I.U.)
<b>Common vegetables</b>								
Beans, snap	4/5 cup	151	4.0	24	n.a. <sup>v</sup>	1.62	19	600
Broccoli	2/3 cup	267	15.3	27	2.51	1.33	90	2328
Carrots	2/3 cup	341	47.2	30	1.83	0.93	5	3530
Lettuce	2 cups (chopped)	185	0.8	20	0.86	0.54	6	360
Peas	1/2 cup	315	1.5	75	0.44	3.76	21	680
Potatoes	1/2 baked	305	3.5	29	1.40	1.60	20	tr.
Strawberries	2/3 cup	146	1.3	30	0.53	1.90	57	27
Summer squash	1/2 cup (cooked)	125	2.5	18	n.a.	1.20	15	95
Sweet corn	1/2 cup	184	4.2	65	n.a.	n.a.	9	35
Tomatoes	2/3 cup	215	5.0	15	0.72	0.58	23	660
<b>Tropical vegetables</b>								
Boniato	1/2 cup (cooked)	210	31.0	121	n.a.	0.8	31	30
Calabaza	1/2 cup (cooked)	351	7.0	65	n.a.	0.8	15	920
Cassava	3 x 2 inch piece	n.a.	n.a.	357	n.a.	1.0	19	tr.
Chayote	2/3 cup (raw)	108	2.0	20	n.a.	0.6	19	20
Malanga	1/2 cup (cooked)	n.a.	n.a.	137	n.a.	1.0	n.a.	n.a.
Pigeon pea	1/2 cup (dry)	654	26.0	345	n.a.	4.4	39	140
Plantain, green	3 x 2 inch piece	499	4.0	127	n.a.	0.4	28	380
Taro	1/2 cup (cooked)	448	10.0	91	n.a.	0.8	7	5

\*Source of information refs. 1, 2, 6, 7, 8, 12, 16.  
<sup>v</sup>n.a. = not available.

of the product. Generally, fiber is classified as dietary (cellulose, hemicellulose, pectin, and lignins) or as simple crude fiber (simply cellulose). Crude fiber represents ca. 20% of total dietary fiber.

The therapeutic effects of fiber in the prevention of heart disease, colon cancer and diabetes has not been definitely established. However, its role in the treatment of digestive disorders (diverticulosis and constipation) is generally recognized.

Limited information is currently available on the total fiber content of many of the Florida tropical fruits and vegetables. Available data point to higher soluble fiber levels in most tropical fruits than in their temperate counterparts. For example, the soluble fiber content (g/100 g) of 6 tropical and temperate fruits is as follows: guava, 5.60; blackberry, 4.10; Florida avocado, 2.11; pear, 1.40; carambola, 0.92; and mango, 0.84. Data on insoluble fiber are incomplete; however, avocados were reported to contain 2.70 g, carambolas 1.15 g and mangos 1.08 g (per 100 g). Mango data are probably for non-fibrous mangos, perhaps not Floridian (Table 1).

Cassava, malanga, and taro contain insoluble fiber levels similar to those of carrots and potatoes. Personal observations indicate that chayotes contain more fiber than summer squash, though these are not substantiated by published data (Table 2).

### Calorie Content

Calories are the body's fuel source. The body uses the calories contained in all foods to provide energy and warmth to the system. Excess calories are stored in adipose tissue for use at times when sufficient calories would not be available otherwise.

The caloric content of tropical fruits is similar to that of other fruits. Carambolas and papaya have the lowest calorie content, less than 50 calories per 100 g serving. Guava, lychee, longans, mamey, mango, and sugar apple have less than 100 calories per 100 g portion. Even the Florida avocado can be considered 'dietetic', containing only 112 calories per 100 g serving (ca. 2/3 cup portion) (Table 1).

*Proc. Fla. State Hort. Soc.* 96: 1983.

### Vitamins A and C

Vitamin A plays an essential role in maintaining the health of the skin and epithelial tissues and of the immune system. It also is necessary for the maintenance and growth of teeth, nails, hair, eyes, bones and glands (15). Vitamin C is needed for collagen production, the substance which gives structure to muscles, vascular tissues, bones and cartilage. It aids the health of teeth and gums and assists in iron absorption (13).

In addition to supplying vitamins A and C, fruits and vegetables in general are excellent sources of other vitamins and trace minerals (micronutrients) which are also necessary for proper nutritional balance. These vitamins and minerals are often lacking from synthetic foods.

Tropical fruits and vegetables are rich sources of vitamins A and C. Papayas and mangos are especially high in vitamin A. Papayas have a vitamin A content of over 2000 I.U. (international units) per serving. Mangos contain nearly 4000 I.U. and several other fruits have significant amounts of vitamin A. For example, red guava contains 792 I.U., followed by avocados with 612, carambolas with 493 and mameys with 230. Common temperate fruits that are assumed to have high levels of vitamin A do not compare to their tropical counterparts. Peaches have a mere 535 I.U. followed by oranges with 200 and sweet red cherries with 214 (Table 1).

Among the tropical vegetables, calabaza is especially noteworthy, containing 920 I.U.'s per serving; the green plantain contains 380 I.U.'s per serving (Table 2).

Contributions of ascorbic acid to the diet by tropical fruits and vegetables could be significant. In comparison with commonly recognized sources such as strawberries with 56.7 mg and oranges with 45.0 mg, tropical fruits provide greater amounts of vitamin C. Red guavas are exceptionally high, contributing 183.5 mg per 100 g of fruit. This is 3 times higher than strawberries and 4 times higher than oranges. Ascorbic acid level in longans is 84.0 mg, while those for lychee and papaya are 71.5 and 61.8 mg, respectively (Table 1).

## Fats and Oils

Fats and oils are recognized as essential nutrients in human and animal diets. They provide concentrated energy, supply essential fatty acids and are carriers of the fat soluble vitamins A, D, E, and K. In addition, they serve to make food more palatable, giving a sense of 'fullness' following a meal. All healthy humans need fats and oils in the diet. The American Dietetic Association suggests that diets contain less than 30% fat. Increasing the consumption of fruits and vegetables will naturally lower the percentage of total fat intake (5).

Fatty acids occurring in edible fats and oils are classified according to their degree of saturation into saturated, monosaturated, unsaturated, and polyunsaturated fatty acids. Cholesterol is often mentioned when discussing dietary fats. Foods of animal origin naturally contain cholesterol (5). Fruits and vegetables contain generally less than 1% fat, except for avocados which contain slightly more. No cholesterol is found in fruits and vegetables.

Although many therapeutic diet plans suggest a lower consumption of fats and cholesterol, the relationship between cardiovascular disease and dietary fats remains unclear and the appropriateness of specific dietary recommendations for the general population is not agreed upon. Diets should not be 'self-diagnosed' without advice from a physician.

Avocados contain more fat than other fruits and vegetables. California cultivars have nearly twice the total fat content of Florida avocados (Table 3).

Florida avocados have a role in providing interest and variety to therapeutic meals. Avocado spread can be substituted for mayonaise on sandwiches and used in salads.

Table 3. Fat content of California and Florida avocados.<sup>z</sup>

	Cal.	Saturated fatty acids (g)	Mono-saturated fatty acids (g)	Poly-unsaturated fatty acids (g)
California Avocados	177	2.59	11.21	2.04
Florida Avocados	112	1.76	4.87	1.48

<sup>z</sup>Source of information ref. 16.

## Summary

The availability of tropical fruits and vegetables is continuing to increase with the diversification of national origin of the American population. This has come about as a result of consumer demand for previously difficult to find items. The role of these tropical products in the American diet becomes more important with increased emphasis on diets which are low in fat, low in sodium, low in calories, and high in both potassium and vitamins.

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