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What's in Your Tropical Fruit?[1]

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Introduction

Fruits are abundant in nutrients, such as fiber, potassium, folate, and Vitamin C. Moreover, they also contain carotenoids and polyphenols, which act as antioxidants within the body. Eating large amounts of plant-based foods has been associated with lowered rates of cardiovascular disease (1, 2) and with decreased risk of cancer and stroke (2). Consuming adequate fruits and vegetables provides both essential nutrients and compounds that provide other beneficial physiological effects, not all of which are known.

The nutrient composition of tropical fruits is of particular interest not only because of the health benefits of fruit consumption, but also because of the importance of tropical fruits to the agricultural industry in Florida. In 2003, Florida ranked ninth in the nation for total cash receipts from fruit, with nearly 28% of this from field crops and other crops not including vegetables. Additionally, Florida's top export is fruit; in 2003, Florida ranked second in the nation in fruit exports (3). Since the production of tropical fruits is an important part of the economy of the state, highlighting the nutritional benefits of these fruits enhances their marketability and appeal.

However, the lack of comprehensive information about the nutritional properties of these foods presents a challenge. The purpose of this publication is to evaluate the current information available on the nutrient composition of tropical fruits. The nutrient information (amounts of fiber, Vitamin A, Vitamin C, folate, potassium, calcium and iron) for the tropical fruits examined was compiled from the USDA National Nutrient Database for Standard Reference (4, 5) (see Table 1). These values were then compared to the daily reference values for food labeling (6) and evaluated in relation to the percent provided per serving. According to the FDA, a "good" source of a nutrient provides 10-19% of the daily reference value, while an "excellent" source provides 20% of the daily reference value (6, 7). Scientific names for fruits not found in the USDA Nutrient Database were found in Morton's Fruits of Warm Climates (8). The tropical fruits chosen for this analysis were selected because they are currently of interest to local growers and to food and dietary supplement manufacturers in and around the state of Florida.

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Nutrients

Fiber helps maintain intestinal function, reduces the risk of heart disease, and can help keep blood glucose levels normal. Sapodilla, kumquat, durian and avocado were found to have the highest amounts of fiber of the fruits evaluated. Kumquat and sapodilla, at 6.4 g and 5.4 g of fiber per serving, respectively, both provide more than 20% of the daily reference value for fiber, and therefore are excellent sources of fiber.

Vitamin A is important for vision, expression of genes, growth, and development, as well as proper immune function (9). Passion fruit juice (89 µg/serving), pitanga (65 µg/serving), acerola (60 µg/serving), and plantain (41 µg/serving) contain the highest amounts of Vitamin A of the tropical fruits evaluated. Despite these fruits' high levels of Vitamin A when compared to the other fruits evaluated, these three fruits are not considered "good" or "excellent" sources of the vitamin. More research into beta-carotene and its contribution to vitamin A value is needed.

In the body, Vitamin C is used as a cofactor for many metabolic reactions; it also serves as an antioxidant (9). Many of the fruits evaluated are high in Vitamin C. Acerola juice, which contains 3872 mg per serving, and raw acerola cherries, which contain 822 mg per serving, are extraordinarily high in Vitamin C. Guava, which contains 188 mg per serving, is also an excellent source, followed by passion fruit juice (74 mg/serving), longan (70 mg/serving), and lychee (70 mg/serving).

Calcium is necessary for blood clotting, muscle movement, and transmission of nerve signals, and is important for formation of bones and teeth (9). Of the tropical fruits evaluated, kumquat (62 mg/serving), mamey sapote (39 mg/serving), and sapodilla (25 mg/serving) contain the most calcium; however, none of these fruits are considered "good" or "excellent" sources of calcium. (Fruits are not typically good sources of calcium.)

Iron is a component of enzymes and hemoglobin in the body and prevents anemia (9). Of the tropical fruits evaluated, acerola, coconut, and sapodilla contained the most iron. All three of these fruits are good sources of iron for males, with a serving of acerola providing 15% of the RDA for males, and servings of coconut and sapodilla providing 12% of the RDA for males; however, these fruits are not considered "good" or "excellent sources" of iron for women, whose RDA for iron is higher. (Fruits are not, in general, good sources of iron.)

Folate is important in metabolic reactions in the body and also prevents certain types of anemia (9). An adequate folate intake prevents birth defects and heart disease. Avocado, durian, and guava are the tropical fruits with the most folate. With 61 µgg/serving, 44 µgg/serving and 40 µgg/serving, respectively, they are considered "good" sources of folate. Data on the folate content of some fruits are nonexistent.

Potassium is important in maintaining the fluid balance of cells. It contributes to normal cell function, helps to counterbalance fluctuations in blood pressure when excess sodium is taken into the body, and decreases markers of bone turnover (9). Of the tropical fruits evaluated, passion fruit juice, durian, plantain, guava, and avocado contained the most potassium. Passion fruit juice, in particular, is an excellent source of potassium, containing almost 700 mg of potassium (20% of the daily reference value) per serving.

Fruits

In addition to vitamins and minerals, a number of the fruits characterized in the USDA database contained other dietary bioactive components, such as carotenoids and polyphenols (Table 2). After noting which fruits had significant quantities of at least three of the nutrients listed in Table 1, we searched the scientific literature for research on the composition of other dietary bioactive components in these fruits. This meant we searched for articles on acerola, avocado, durian, guava, kumquat, passion fruit juice, and sapodilla.

Acerola (*Malpighia glabra, Malpighia emarginata*) is extraordinarily high in vitamin C and is also a rich source of vitamin A, iron, and folate. The fruit juice has also been found to contain carotenoids, such as beta-carotene (10).

Avocado (*Persea americana*) contains alpha and beta carotene and lutein/zeathanthin, but not lycopene (4). Other bioactive food components have not been characterized. The oil of the avocado has received more attention than the edible pulp.

Durian (*Durio zibethinus*) is high in fiber, folate, and potassium; however, no carotenoid or phenolic information is currently available.

Guava (*Psidium guajava*), a source of fiber, vitamin C, folate, and potassium, is also very high in lycopene and beta-carotene (4, 11). Guava also contains ellagic acid, gallic acid conjugates, and quercetin glycosides, but not hydroxycinnamics (12) or cryptoxanthin (4, 11). No derivatives of chlorogenic acids were detected in guava (13).

Passion fruit juice (*Passiflora edulis*) is rich in vitamins A and C, as well as potassium. The predominant carotene is zeta-carotene (14).

Sapodilla (*Manikara zapota*) and **kumquat** (*Fortunella spp.)* are high in fiber, iron, and calcium, as far as fruits go. Two unusual polyphenolic compounds with high antioxidant activity, methyl 4-O-galloylchlorogenate and 4-O-galloylchlorogenic acid (15), have been identified in sapodilla. 5-caffeoylquinte (CQA) (but not 4-CQA) was also found in small quantities in the sapodilla (13). In addition, sapodilla contains catechin conjugates and polyphenols (12). The predominant flavanone in kumquat is narirutin, while the fruit is practically devoid of flavones (16).

Research Opportunities

While information regarding a variety of tropical fruits was found in the USDA food composition database, many fruits have no composition data available. Because of this gap in composition data for tropical fruits, there are many opportunities for research into the nutrient and phytochemical composition of these fruits. Table 3 presents tropical fruits for which no composition data is available from the USDA "What's in the Foods You Eat?" search tool.

Table 3. Tropical fruits lacking compositional information from the USDA National Nutrient Database for Standard Reference

Common name	Scientific name
Abiu	*Pouteria caimito*
Ambarella	*Spondias dulcis Forst., Spondias cytherea Sonn*
Annon (sugar apple, custard apple)	*Annonaceae squamosa*
Araza (Araçá-boi)	*Eugenia stipitata*
Black carrot	*Daucus carota*
Black sapote (chocolate pudding fruit)	*Diospyros digyna, Diospyros obtusifolia*
Camu-camu (camocamo, cacari)	*Myrciaria dubia*
Cashew fruit (cashew apple)	*Anacardium occidentale*
Cili fruit (chestnut rose)	*Rosa roxburghii tratt*
Cupuacu	*Theobroma grandiflorum*
Jabuticaba (Brazilian grape tree)	*Myrciaria cauliflora*
Jackfruit	*Artocarpus heterophyllus*
Key lime	*Citrus aurantifolia*
Monstera (ceriman)	*Monstera deliciosa*
Pitahaya (dragonfruit, strawberry pear)	*Hylocereus undatus* and hybrids
Pupunha (Pejibaye, peach palm, pewa, peach nut, pejibave)	*Bactris gasipaes*
Sea buckthorn	*Hippophae rhamnoides*
Wax jambu (Java apple)	*Syzygium samarangense, Syzygium javanicum, Eugenia javanica*
White sapote	*Casimiroa edulis*
Wolfberry	*Lycium pallidum, Lycium chinense*

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Table 1. Nutrient composition of tropical fruits

Common name	Scientific name	USDA food composition form	Amount	Fiber (g)	Vitamin A (RAE)	Vitamin C (mg)	Calcium (mg)	Iron (mg)	Folate (mcg)	Potassium (mg)
Acerola (Barbados cherry)	*Malpighia glabra*	Juice	1 cup (8 oz.)	0.7	60	3872	24	1.21	34	235
		Fruit (raw)	1/2 cup	0.5	19	822	6	0.1	7	72
Asian pear	*Pyrus pyrifolia*	Fruit	1/2 cup	3	0	3.2	3	0	7	100
Avocado	*Persea americana*	Fruit	1/2 cup	5	5	7.5	9	0.41	61	364
Banana	*Musa paradisiaca*	Fruit	1/2 cup	1.9	2	6.5	4	0.20	15	268
Carambola (Star fruit)	*Averrhoa carambola*	Fruit	1/2 cup	1.5	2	19	2	0.04	6	72
Cherimoya	*Annona cherimola*	Fruit	1/2 cup	1.8	0	9	6	0.23	14	210
Coconut	*Cocos nucifera*	Fruit (raw)	1/2 cup	3.6	0	1.3	6	0.97	10	142
Durian	*Durio zibethinus*	Fruit	1/2 cup	4.6	2	24	7	0.52	44	530
Guanabana (Soursop)	*Annona muricata*	Fruit	1/2 cup	3.7	0	23	16	0.68	16	313
Guava (red)	*Psidium guajava*	Fruit	1/2 cup	4.5	26	188	15	0.21	40	344
Kumquat	*Fortunella spp.*	Fruit	1/2 cup	5.4	12	36	51	0.71	14	154
Longan (Dragon's eye)	*Dimocarpus longan*	Fruit	1/2 cup	0.9	NA	70	1	0.11	NA	221
Lychee	*Litchi chinensis*	Fruit	1/2 cup	1.2	0	68	5	0.29	13	162
Mammee apple	*Mammea americana*	Fruit	1/2 cup	2.5	10	12	9	0.58	12	39
Mango	*Mangifera indica*	Fruit	1/2 cup	1.5	31	23	8	0.11	12	129
Papaya	*Carica papaya*	Fruit	1/2 cup	1.3	38	43	17	0.07	27	180
Passion fruit	*Passiflora edulis*	Juice	1 cup (8 oz.)	0.5	89	74	10	0.60	17	687
Pitanga (Surinam cherry)	*Eugenia uniflora*	Fruit	1/2 cup	NA	65	23	8	0.17	NA	89
Plantain	*Musa x paradisiaca L.*	Fruit	1/2 cup	1.7	41	14	2	0.44	16	369
Pummelo	*Citrus grandis*	Fruit	1/2 cup	0.9	0	58	4	0.10	NA	205
Sapodilla	*Manilkara zapota*	Fruit	1/2 cup	6.4	4	18	25	0.96	17	233
Mamey sapote	*Pouteria sapota*	Fruit	1/2 cup	2.2	17	17	32	0.83	NA	286

Table 2. Carotenoid and phenolic compounds identified in select tropical fruits

Fruit	Scientific Name	Cryptoxanthin	Lycopene	Beta-carotene	General Phenolic	4-CQA	5-CQA	Catechins
Acerola	*Malpighia glabra*			x	x			
Banana	*Musa spp.* and hybrids	x	x	x			x	
Guava	*Psidium guajava*	x	x	x	x			
Mango	*Mangifera indica*	x	x	x		x	x	
Papaya	*Carica papaya*	x	x	x				
Starfruit (carambola)	*Averrhoa carambola*	x	x	x	x			
Sapodilla	*Manilkara zapota*				x		x	x
Mamey sapote	*Pouteria sapota*				x			x