Guava as a Superfruit

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Guava	:	*Psidium guajava* L.
Family	:	Myrtaceae
Origin	:	Tropical America
Growing countries	:	> 75
Major growing countries	:	India, Mexico, Brazil, Cuba, Thailand, Malaysia, Australia, South Africa, China, The Philippines, Sri Lanka, Venezuela, USA (Florida), Myanmar etc.

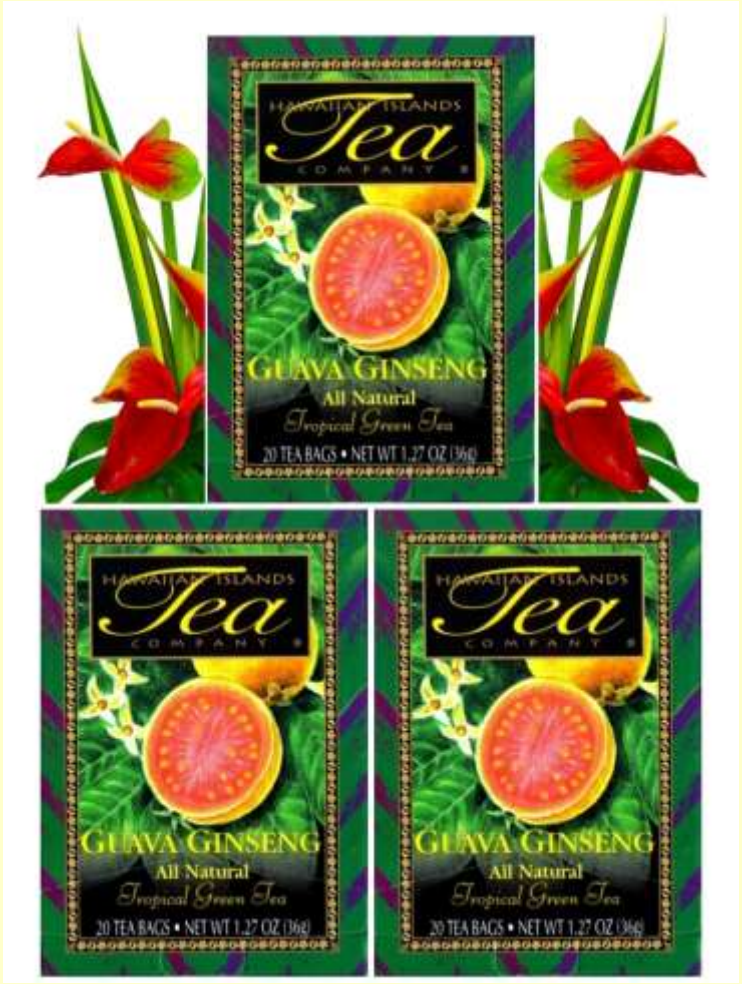
Fruits - consumed fresh or in processed form.

❖beverage, syrup, ice-cream, cheese, toffee, jam, juice, wine, and dehydrated and canned products.

- and has many nutritional and health effects (Gutierrez et al., 2008; Abubakar, 2009; Antonio et al., 2011).

In Taiwan - hypoglycemic agent in folk medicine. Leaves and skin of the fruit have greater effects.

Guava tea, the infusion of dried guava fruit and leaves, has recently become popular as a drink in Taiwan (Chen and Yen, 2007).



Nutritional Value per 100g

Carbohydrate	: 14-17g
Sugar	: 8-11g
Dietary fiber	: 5-7g
Fat	: 0.95-1.2g
Protein	: 2.5-3.0g

Minerals

Iron	: 0.26mg
Calcium	: 18mg
Magnesium	: 22mg
Phosphorus	: 40mg
Potassium	: 417mg
Sodium	: 2mg
Zinc	: 0.23mg

Contd……

Vitamin A equivalent	: 31µg	Vitamin B6	: 0.11mg
- Beta carotene	: 374µg	Folate (Vitamin B_6)	: 49µg
Thiamine (vitamin B_1)	: 0.067mg	Choline	: 7.6mg
Riboflavin (Vitamin B_2)	: 0.04mg	Vitamin C	: 228.3mg
Niacin (Vitamin B_3)	: 1.084mg	Vitamin K	: 2.2µg
Panthonic acid (Vitamin B_5)	: 0.45mg	Lycopene	: 5204µg

Kumari *et al.* (2013)

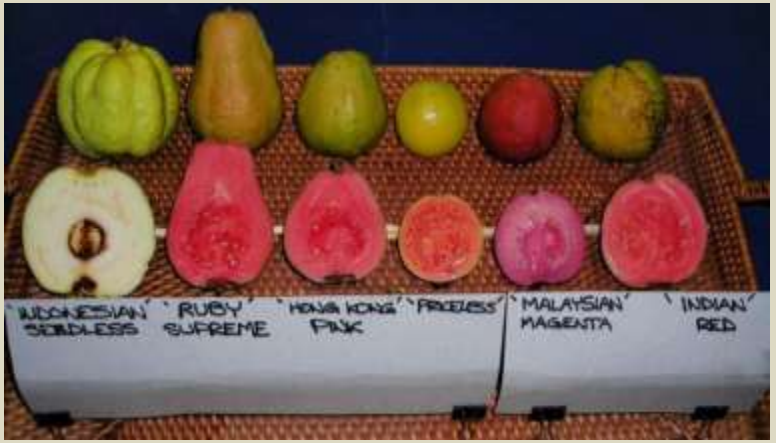
Photochemical in guava

The main photochemical found in guava

- Ascorbic acid (60-300mg/100g)
- Antioxidant –containing dietary fiber
- Carotenoids
- polyphenoles

Ascorbic acid and other antioxidant vitamins

- Ascorbic acids (60-300mg/100g)
- AA is concentrated in the skin, followed by mesocarp and endocarp
- Alpha- tocopherol (vitamin E) – 1.7 -2.0mg/ 100g; is an important fat-soluble dietary antioxidant.



Dietary Fiber

- Dietary fiber in food is associated with a reduction in colon and other cancer risks.
- Soluble fiber content is generally associated with a reduced risk of cardiovascular disease.
- Guava fruits have very high total (5.60g/ 100g) and dietary fibers (2.70g/ 100g) (Gorinstein *et al.,* 1999).
- Pulp and peel of guava fruit is a potent source of radical-scavenging compounds, because of high content of cell-wall bound polyphenolics (2.62-7.79% w/w basis) (Jimenez –Escrig *et al., 2001)*

Total dietary fiber (TDF) and pectin for selected Florida-grown tropical fruits*

Fruit	TDF g/100g fruit	Pectin g/100g fruit
Guava (red)	7.2 ± 0.0	1.04 ± 0.02
Mamey sapote	6.1 ± 0.0	0.77 ± 0.02
Sapodilla	4.4 ± 0.1	0.35 ± 0.01
Guava (white)	4.0 ± 0.1	0.77 ± 0.01
Dragon fruit (red)	3.2 ± 0.1	0.27 ± 0.01
Papaya (green, 'Exp.15')	2.1 ± 0.0	0.60 ± 0.02
Papaya (green, 'Red Lady')	1.8 ± 0.0	0.51 ± 0.01
Mango (Green)	1.6 ± 0.0	0.48 ± 0.01
Lychee	1.6± 0.0	0.48± 0.01
Papaya (ripe, 'Red Lady')	1.5± 0.1	0.49± 0.01
Mango (ripe)	1.4± 0.0	0.51± 0.01
Carambola	1.3± 0.0	0.27± 0.01
Dragon fruit (white)	1.1± 0.0	0.12± 0.00
Longan	0.9± 0.0	0.20± 0.00

Data for TDF and pectin are 95% confidence interval
Mahattanatawee *et al.* (2006)

* Baldwin *et al.*, (2008)

Carotenoids and Lycopene

- Due to their antioxidant properties, carotenoids have shown beneficial health effects in cancer inhibition, immuno-enhancement, and prevention of cardiovascular diseases (Wilberg and Rodriguez-Amaya, 1995).
- Lycopene has received considerable attention due to diverse reporting on the effect of dietary Lycopene in reduction of the risk of prostate cancer and coronary heart disease (Rao and Agarwal, 1999). Lycopene has super antioxidant activity in relation to lutein or β-carotene (Lin and Chen, 2003)

- β – carotene concentration in ripe guava fruits ranged from 0.3 – 0.5mg /100g; while the lycopene concentration ranged from 4.8-5.4mg/100g (Wibery and Rodriguez-Amaya, 1995).
- Lycopene content in ‘Beaumont’ variety has been found to be about 5-7mg/ 100g.

Ascorbic acid content, Lycopene and β-carotene content (mg/100g) in guava, Tomatoes (raw and cooked), Honey and Red Wine

Samples	Ascorbic acid	Lycopene	β -carotene
Guava	216.05±9.64a	5.10±0.85e	0.38±0.11i
Raw tomatoes	21.14±1.00b	2.45±0.14f	0.43±0.10i
Cooked tomatoes	15.53±1.00c	3.00±0.05e	0.33±0.00j
Honey	0.48±0.01d	5.13xE6±0.01g	1.78xE-7k
Red Wine	< 0.0001	3.12xE6±0.00gh	9.93xE-4j

Nwaihi *et al.* (2015)
International Journal of Current Microbiology and Applied Science. (2015) 4(2): 39-93

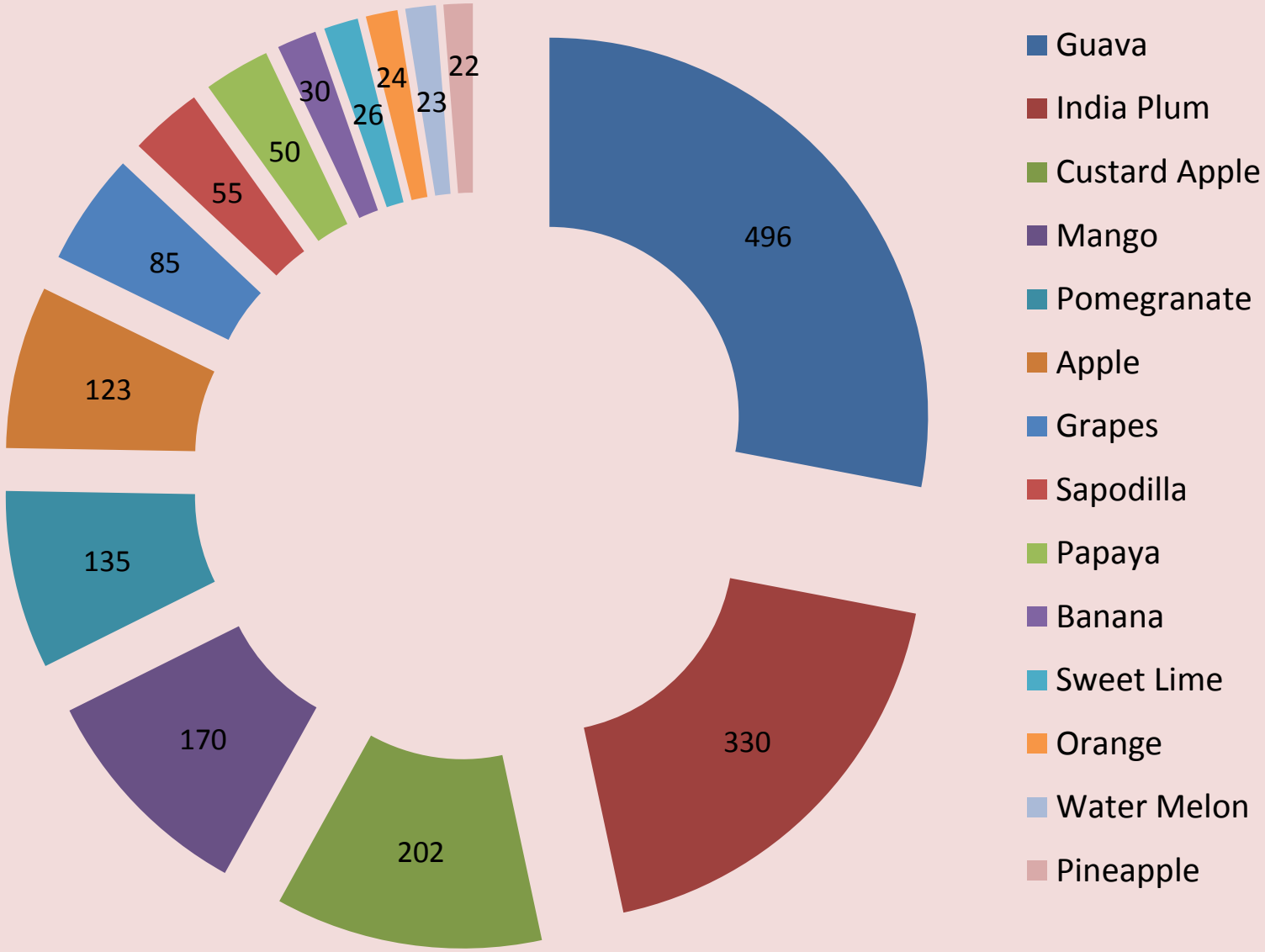
Relative anti-oxidant capacity of selected fruits

Fruit	µmol Trolox Equivalents/ 100g*
Guava	1670 (red-fleshed)
Carambola	1290
Pitaya	760 (red fleshed)
Mamey Sapota	660
Lychee	540
Papaya	530
Longan	330
Mango	220
Sapodilla	140

* Mahattanatawee *et al.* (2006)

Indian Fruits: Antioxidant Level Index

(mg/100g)



Polyphenolics

- Polyphenols are the most abundant photochemical in our diets, and fruits are the main contributors.
- Young guava fruit have about 620mg/100g tissue total phenol, with about 65% present in the form of condensed tannins (Itoo *et al.,* 1987).
- The major polyphenols found in guava fruits are the flavans, notable (+) -catechin and (+) –gallocatechin (Itoo *et al.,* (1987).

- Guava fruit contain high amount of total phenolics (4.95mg/100g) and gallic acid (0.374mg/ 100g) (Gorinstein *et al.*, 1999).

- Guava are somewhat unusual in their flavonoid polyphenolic content as well, with significant levels of myricetin (55mg/ 100g) and apigenin (58mg/ 100g) (Miean and Mohammed, 2001).

Traditional medicinal use of guava

Country	Plant parts/ fruits used	Use	References
Mexico	Fruit + leaves, shoots and barks	Decoction for treating obstetric problems, hypoglycemia, skin disorders, dental caries, wounds, dehydration.	Gutierrez *et al.* (2008); Heinrich *et al.* (1998)
Brazil	Ripe fruit together with flowers and leaves	Decoction in treating anorexia, cholera, diarrhea, dysentery, laryngitis, sore throat, oral ulcer, skin problem	Gutierrez *et al.* (2008)
Africa	Fruit	Dysentery	Muller and Mechler (2005)
Sudan	Fruit peel	Decoction to relieve coughing	Muller and Mechler (2005)
China	Fruit	Non insulin dependent diabetes mellitus.	Muller and Mechler (2005)

Characteristics of human subjects used to investigate the effect of consuming Thai Seedless guava in normal male youth (Mean ±S.D)

Details (n=28)	Mean ± S.D
Age (years)	19.25 ± 1.90
Weight (kg)	56.22 ± 9.57
Height (cm)	165.73 ± 4.32
BMI (kg/m^2)	20.47 ± 3.37

Rahmat *et al.* (2006), Age: 18-24 years, Normal fasting glucose (3-7mmol/l), Normal total cholesterol level (<5.2 mmol/l), Do not consume any medicine or supplements

Comparison of glucose level and lipid profile (mmol/l) during baseline treatment and control phase

	Baseline (First week)	Treatment (Fifth week)	Control (ninth week)
Energy (kcal)	2192.23±311.54	2547.91±178.68*	2180.14±199.95
Glucose	4.43±0.62	5.36±1.19*	6.71±1.25
Total cholesterol	3.78±0.63	4.60±0.97*	3.60±0.51
Triglyceride	0.48±0.27	1.34±0.37*	0.89±0.47
LDL- Cholesterol	2.63±0.59	2.75±0.77	2.33±0.53
HDL- Cholesterol	0.92±0.16	1.36±0.37*	0.88±0.22
Total antioxidant status	1.24±0.14	1.78±0.22*	1.35±0.21

* Significantly different ($p < 0.05$) compared to baseline and control.
Baseline: Diet study for one week, Treatment: 4 weeks diet + 400g of Thai Seedless guava/day, control: No guava supplement for next 4 weeks.

What the result speaks:

a) Increase in the blood glucose level- associated with high fiber content of guava (5-7g fiber/100g). Fruits that have high fiber content are able to control glycemia by reduce the absorption of glucose in the intestine (Anderson *et al.,* 1988).

b) Significant increase in total cholesterol, triglyceride and HDL-cholesterol in treatment phase but no significantly difference in LDL-cholesterol.

- Increase of total cholesterol and triglyceride were still with in the normal range.

- Increase in HDL-cholesterol was associated with decrease risk of heart attack and cardiovascular disease.

- Significant increase in total antioxidant status during treatment phase- associated with decreased risk of diseases mediated by free radicals such as cancer (Polidori *et al*., 2001)

Use in oral care

✓The cytotoxic property of guava would be of added value for the use of guava as adjuncts in the development of oral health care products (Fathilah et al., 2010).

✓Aqueous extracts - antiplaque activity by their effect on ultrastructure of plaque bacteria by interfering with normal growth cycle and development (Fathilah et al., 2009) without disrupting homeostasis of the oral cavity (John et al., 2013).

✓Guava extract has demonstrated *in vitro* antiplaque actions by inhibiting growth, adherence and coaggregation of dental plaque bacteria.

Fruit Peel

- Guava peel contained 29.2±2.1 mg/100 g of catechin, 68.2±3.6 mg/100 g of galangin, and 10.2±0.5 mg/100 g of homogentisic acid (Chen et al., 2015).

- Ascorbic acid is the main constituent of the skin (Charles et al., 2006).

- The non-peeled fruit has higher total phenol and ascorbic acid contents compared to the peeled fruit.

✓Hypolipidemic and hepatoprotective effects in diabetic rats treated with aqueous extract of lyophilized guava peel (Rai et al., 2012).

✓Several compounds - catechin, galangin, homogentisic acid, gallic acid, kaempferol and cyanidin 3-glucoside to be the active components of guava, and the contents of these compounds in guava peel and seed were higher than that in guava flesh (Chen et al., 2015).

✓Guava fruit peel extract could reduce oxidative stress of pancreas in streptozotocin-induced diabetic rats (Budin et al., 2013).

Seeds

❖Guava seeds have been reported to contain 14% oil, 15% protein and 13% starch (Burkill, 1997).

❖Phenolic and flavonoid compounds including ellagic, gallic, and caffeic acid, methyl gallate, 8,3'-dimethoxy gossypetin, quercitin 3-o-glucoside with the aglycones kaempferol, quercitin and myricetin along with the natural acylated flavonol glycoside has been identified in seeds (Michael et al., 2002).

❖Ethanolic guava meal extract (EGME) possess potential anticarcinogenic properties. Chlorogenic acid, caffeic acid, ferulic acid and *O*-coumaric acid were identified in EGME (Mohamed et al., 2011).

❖The seed contains glycosides, carotenoids, phenolic compounds having antimicrobial actions (Gupta et al., 2011).

✓**These antioxidant extract can be used as preservatives in foods such as edible oils (Castro-Vargas et al., 2012).**

✓**Wistar rats treated with guava seed had significantly lower glycemia, cholesterol and triglycerides levels and body weight. These animals significantly increased HDL-c levels (Farinazzi-Machado et al. (2012).**

✓**Extracts – can be recommended in the management of anaemia and immunity dependent disorders as well as in regulating the cholesterol and triglyceride levels (Kullu et al., 2013).**

Anti cancer

Guava peel, flesh and seed possesses strong antioxidant and anticancer actions – based on evaluation on four cancer cell lines, A549 (human lung cancer cells), MCF-7 (human breast cancer cells), HepG2 (human hepatoma cells) and HT-29 (human colon cancer cells) (Chen et al., 2015) .

Guava aqueous extract - killing prostate cancer LNCaP cells (Hsieh and Peng, 2010).

❖By-product of pink guava puree industry can be a potential source of lycopene and antioxidant comounds.

Why Guavas Should Be Considered A Superfood

Guavas have the highest concentration of antioxidants that protect against cell damage which ages skin and can cause cancer. This inexpensive and humble food should be regarded as one of the top 'superfoods' nature has blessed us with.

Conclusion

- Antioxidant is present in varied forms in guava like β-carotene, lycopene, flavanoids, vitamin C, dietary fiber, polyphenols etc which are active scavengers of free radicals.
- Posses numerous medicinal properties such as anti-allergenic, anti-artherogenic, anti-inflammatory, anti-microbial, anti-thrombotic, anti-cancer, cardioprotective, and anticarcinogenic effects etc.
- Clinical tests also suggests the potential to reduce blood pressure, cholesterol and triglycerides.

•Consumption of this fruit has numerous health benefits - rich vitamins and minerals and can be helpful to prevent risk factors of many diseases due to bioactive compounds present.

•All the parts of the fruit i.e., the pulp, peel and seed possess nutritional and medicinal properties, and can also be used for development of functional foods, and in pharmaceuticals for disease prevention.

Thus, guava is considered a ‘superfruit.’


Thank you