



## A Perspective Review on the Phytochemistry of Papaya and Its Nutritional Value

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### Abstract

C. Papaya. Linn (Papaya) is a well-known tropical and sub-tropical fruit that finds excellent nutritional and medicinal value and in fact, the whole parts of the plant i.e., fruit, roots, bark, peel, seeds, and pulp possess medicinal characteristics. Its fruit is not only delicious and energetic but also contains a higher amount of antioxidants such as vitamins A, C and E and minerals deposits such as Ca, K, Mg, Fe, Zn, Mn, Cu, and dietary fibers. It contains beta-carotene, calcium, alkaloid, fats, tannin, flavonoids, glycosides, phytates, steroids, tannin as papain and chymopapain which are commonly found in milk sap. Papaya is successfully used to treat the cardiovascular system and acts against many heart diseases particularly heart attacks, heart strokes, inhibits the diabetic disease, prevents intestines cancer in a human. Beta-carotene naturally occurs in papaya that prevents the mutation induced by free radicals in the body.

**Keywords:** *Papaya; Nutritional; Medicinal; Antioxidants; Minerals; Beta-Carotene*

### Introduction

The phenolic and carotenoids compounds are found in a rich amount in tropical fruits are concerned with cultivar, pre and post-harvesting factors. Papaya is a tropical fruit scientifically is known as *Carica Papaya* Linn and belongs to sub kingdom Tracheobionta, phylum Streptophyta, class Magnoliopsida, family Caricaceae, and genus *Carica* [Sule, O.*et al.*, 2012; Ghosh, T.*et al.*]. It is commonly known as Pawpaw (Australia), Mamao (Brazil), Babaya (Arabic), Papaya, Papaya (Bengali), Papaya (English), Melonen Braum (German), Papaya (France), Tree melon (Holland), Papeeta (Hindi), Gedang (Indonesia), Lechosa (Spanish), Pappali, Papaya (Tamil), Papaya, Pawpaw (UK). Papaya was first introduced in 16<sup>th</sup> century and possibly coined in many countries like Sri Lanka, Hawaii, Mexico, Costa Rica India, and all tropical and subtropical regions. India is responsible for the cultivation of 42% world crop [Krishna, K.*et al.*, 2008; Nakasone, H. Y.*et al.*, 1998].

The papaya plant is a tall herbaceous persistent single-stemmed tree with a height

of 20 - 30 ft. The color of stem ranges from light green to dark brown and its diameter about 8 inches [Milind, P.*et al.*, 2011]. The plant is also a polygamous species due to this reason its female, male and hermaphrodite plant species identification in nature is difficult. The papaya is a small, frost-tender, juicy, wide leaved well-known tree that provides papaya fruits during the year. Every bush naturally has an only, unbranched, non-woody stem that bearing the wounds of old leaf bases. The stalk is surpassed by an umbrella-like canopy of palmate lobed leaves. Big, plump, and melon-like fruits of papaya appear in bunches connected to the stem top just below the leaf shelter. Two types of papayas such as small-sized solo type papaya and large-sized papaya are existing in nature [Karunamoorthi, K.*et al.*, 2014]. A large papaya tree plant of 3-10 meters in a height with palm habitat, the plump stem clears with scars whereas leaves have dropped off, is overcome through an incurable panache of leaves on long petioles

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with five to seven lobes has been shown in figure 1 [Vij, Tarun.*et al.*, 2015].

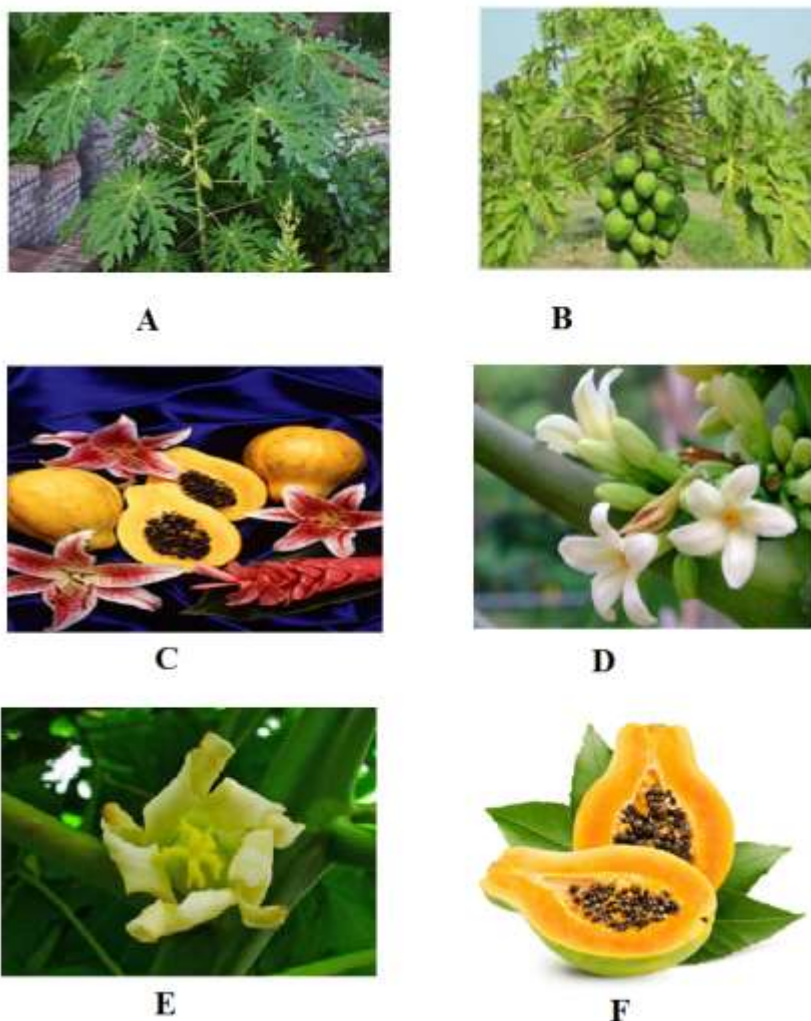
Papaya leaves arranged in different fashion may arrange in spiral arrangement near the apex of trunk; long, heavy, greenish or purplish-green petiole of one meter in a length: lamina orbicular of 25- 75 cm in width, palmate, extremely seven lobed, glabrous, flagrantly veined: lobes deeply and approximately toothed as shown in figure 2A. The unripe fruit of the papaya is greenish while ripped fruit yellow color as shown in figures 2B and 2C respectively[ Vij, Tarun.*et al.*, 2015]. Papaya plants may be hermaphroditic or dioecious growing only male and female or bisexual flowers as shown in figures 2D and 2E respectively. Papaya has small size flowers with yellow and funnel-shaped, solitary or clustered in the leaf axils. The male flowers arise on large panicles, bearing ten stamens in two rows; the gynoecium is totally disappeared except for a pistil lode. The female flowers are 3-5 cm long with the large functional pistil, no stamens, and an ovoid-shaped ovary. The shape of the female flower is like pear when

not opened [Yogiraj, V .*et al.*, 2014]. Fruits of Papaya are large in size, oval and cylinder-shaped, and fleshly orange pulp, hollow berry when it ripe it shows yellowish skin. The weight of Papaya fruit Fruits is 0.5 up to 20 lbs. Papaya seeds are small in size, black round and covered with gelatinous [ Facts, D .*et al.*, 2010]. Papaya containing black seeds (Figure 2F) is eatable and has a sharp spicy taste. Black seeds are also used as an alternative for black pepper. In papaya, there are three different methods for pollen transfer i.e. self-pollination, pollen on the different flowers with the help of the same plant, pollen from different plants. Bisexual flowers of C. Papaya always show self-pollination but female plants must show cross-pollination [Vij, Tarun.*et al.*, 2015].

The phytochemistry, nutritional and medicinal value of plants are recently under common investigations nowadays [ Naseer, S .*et al.*, 2018; Rehman, A .*et al.*, 2018]. The current studies were conducted to review the same properties of Papaya which is a common edible fruit.



**Figure 1:** Papaya plant and its various parts



**Figures 2(A-F):** Papaya leaves (A), unripen green fruits on tree (B), ripen yellow fruits (C), male flowers (D), female flowers (E) and fruit showing black seeds (F), Fruit showing inner seeds

### Phytochemistry of *C. Papaya* Linn

Papaya contains many phytochemicals such as alkaloids, tannin, flavonoids, glycosides, phytates, steroids, tannin as papain and chymopapain which commonly found in milk sap. It is also a rich source of Nutrients and antioxidants include Carotene, Ascorbic Acid, Vitamin B, Vitamin E, Vitamin K, and

Vitamin A and comprise substantial quantities of the mineral deposits such as Ca, K, Mg, Fe, Zn, Mn, Cu, and dietary fiber. Papaya leaf contains beta carotene calcium, alkaloid, fats, tannin, and ascorbic acid. Table 1 demonstrates the chemical composition of *C. Papaya* Linn.

**Table 1:** Chemical composition of *C. Papaya* Linn

Chemical constituents	C. Papaya Parts
Enzymes: Papain, Chymopapain	Unripe Fruit
Vitamin: Vitamin C, Thiamine, Riboflavin, Niacin Complex biomolecules: Carbohydrate, proteins, and fats Minerals: Phosphorus, iron, calcium Amino acids Carotenes Fibers Organic acids: citric acids and malic acid (green fruits) Volatile compounds: Linalol, benzylisothiocynate, cis and trans 2, 6-dimethyl-3,6 epoxy-7 octen-2-ol	Fruit

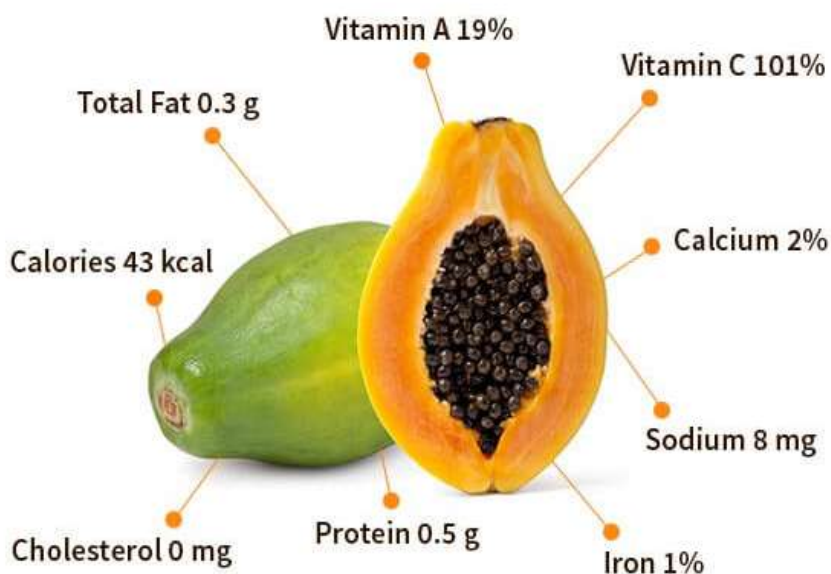
Alkaloid and Glucosides: $\alpha$ ; carpaine, benzyl- $\beta$ -D-glucoside, 2-phenylethyl- $\beta$ -D-glucoside, 4-hydroxyl-phenyl-2-ethyl- $\beta$ -D-glucoside and four isomeric malonated benzyl- $\beta$ -D-glucosides	
Carposide, Enzymes Myrosin, Arposides	Roots
Glucosinolates Papaya oil Benzyl Isothiocyanate Fatty acids Crude proteins Crude fiber Carpaine Benzylisothiocyanate Benzylglucosinolate Glucotropacolin Benzylthiourea Hentriacontane, $\beta$ -sistosterol Caricin and an enzyme Myrosin	Seeds
Minerals Ca, K, Mg, Zn and Fe Flavonoids and Myriceten	Shoots
Alkaloids: Carpain, Pseudocarpain and Dehydrocarpaine I and II, Choline, Carposide Vitamins: Vitamin C and E	Leaves
Carbohydrates: Glucose, Fructose, Sucrose, Galactose and xylitol, $\beta$ -sistosterol	Bark
Enzymes: Proteolytic enzymes, papain and chemopapain, glutamine cyclotransferase, chymopapain A, B and C, peptidase A and B and lysozymes	Latex

### Nutritional Value of Papaya Fruit

The developed 0.1 Kg papaya fruit contains 163 KJ energy, 0.6g protein, 0.1 g Fat, 0.5 g Mineral (Ca, k, Mg, Fe, Zn, Na), 7.2g carbohydrates, 888 $\mu$ m beta-carotene, 8 mg Na, 0.10g Fe, 3 mg niacin and 90 % water. It is also an excellent source of Vitamin A, Vitamin B, and Vitamin G. Papaya juice also consists of many phytochemicals such as alkaloids, tannin, flavonoids glucosides, etc. [ Vij, Tarun. *et al.*, 2015]. Low calories in

papaya but rich in minerals and vitamins. It also contains potassium (223 mg of unmarked fruit). Almost 100 grams of fresh fruit contains 108 mg of ascorbic acid (Vitamin C). Glucose, fructose, and sucrose are the key carbohydrates in papaya [ Saeed, F. *et al.*, 2014]. Figure 3 displays various nutritional components of C. Papaya Linn.





**Figure 3:** Nutritional components of *C. Papaya* Linn

### Medicinal and Pharmacological Actions of Papaya

Papaya fruits, seeds, leaves, and all parts have a wide range of pharmacological activities such as antiseptic, antimicrobial, and parasitic, anti-inflammatory, antihypertensive, diuretic, antihyperlipidemic, antidiuretic, and contraceptive activity [Aravind, G .et al., 2013] and as anti-inflammatory [ Panda, S .et al., 2018].

*C. Papaya* Linn is a valued plant having medicinal importance. Antioxidants as vitamin C and vitamin E, minerals as Mg and K, and some enzymes in the various parts of papaya plants play an important role to treat cardiovascular diseases like heart diseases, heart attacks, strokes and preventing colon cancer. It is also one of the best sources for beta-carotene which inhibits stimulation produced by free radicals which cause certain forms of malignancy. It is observed that it helps in the inhibition of diabetic and heart disease [ Sastri, B. N .et al.,

1950]. *C. Papaya* contains many biological compounds such as digestive enzymes chymopapain [Milind, P .et al., 2011]. Alkaloids are also present in papaya which can be used as a heart depressant. Papaya leaf juice is also much benefited for cancer, tumors, skin diseases, nervous pains, asthma, and elephantoid growths. The root of papaya is used for the treatment of uterus cancer syphilis infection. It is also useful for the removal of mineral concentration from urine. Papaya unripe and ripe fruit also has medicinal properties: unripe parts of papaya are useful for labor; abortion, stimulate lections on the other hand rip fruit is used for the alkalizing of urine. Papaya seeds are used for the intestinal worm to stimulate the menstrual cycle and also for abortion [ Gill, L .et al., 1992; Owoyele, B. V .et al., 2008]

Table 2 demonstrates the pharmacological and medicinal importance of *C. Papaya* Linn.

**Table 2:** Pharmacological and medicinal importance of *C. Papaya* Linn

No	Parts	Medicinal uses
1	Seed	Protect the kidneys from toxin - induced kidney failure Skin irritant to lower fever Cure for piles and typhoid, anti-fertility agent in males Carminative

		Emmenagogue Abortifacient As a paste in the treatment of ringworms
2	Seed juice	Bleeding piles, Enlarge liver , spleens
3	Fruit	Indigestion avoids the heart attack or stroke, relieves obesity bleeding piles wound of urinary tract Ringworm and skin diseases, carminative dysentery
4	Unripe Fruit	Laxative Diuretic dried fruit enlarge liver and spleen Abortifacient, anti-implantation ,antimicrobial activity
5	Leaves	Dengue fever Young leaves are used for jaundice Dressing wounds Urinary complaints Cancer cell growth inhibition As an acne medicine Increase appetite Ease menstrual pain Meat tenderizer And Relieve nausea.
6	Flower	Febrifuge, Jaundice
7	Latex	Intradiscal injection Anthelmintic Relieves Dyspepsia Pain of burns bleeding Stomach Whooping cough
8	Roots	Stomach disorder or cramp, Abortifacient, irregular bleeding from uterus ,piles,
9	Peels	Muscle Relaxant, Sunscreen and soothing slave, Fight dandruff,
10	Stem bark	Jaundice, sore teeth, antifungal activity[ Facts, D .et al., 2010]

### Antimalarial and Antiplasmodial Activity

Papaya leaves are benefited for malaria treatment. It has been noted that papaya leaves also show antimalarial and anti-plasmodium activity but it is unable to understand the mechanism of this activity [ Ahmad, N .et al., 2011]. Papaya leaves also have extensive use in tea making for the treatment of malaria. Papaya plant leaves contain karpain a chemical compound which destroys the microorganisms that often involve in a digestive function [ Peter, J. K .et al., 2014].

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### Anti-sickling Activity

The present investigation shows that papaya also having an anti-sickling activity. Anti-sickling membrane stabilizing activities of C. Papaya as well as its toxicity profile is investigated [ Imaga, N. O. A .et al., 2009].

### Antioxidant and Free Radical Scavenging Activity.

All parts of papaya are the rich source of antioxidants contain high amount of antioxidant such as carotene, ascorbic Ac-

id, Vitamin B, Vitamin E, Vitamin K, and Vitamin A and comprise substantial quantities of the mineral deposits such as Ca, K, Mg, Fe, Zn, Mn, Cu and dietary fiber. Papaya leaf contains beta carotene, calcium, alkaloid, fats, tannin, and ascorbic acid.

The antioxidant activity of different orange peels extracts was measured on the basis of the free radical scavenging effects of the stable 1,1-diphenyl-2-picrylhydrazyl (DPPH) by comparing with its control standard. The solution mixture was made in methanol was kept in dark for 30 minutes and optical density measured at 517 nm, using a UV-VIS spectrophotometer. Methanol was taken as blank. The optical density was noted, and the percentage of inhibition was calculated using the formula as given below: % inhibition of DPPH radical =  $\frac{\text{Abs. of control} - \text{Abs. of sample}}{\text{Abs. of control}} \times 100$

**FRAP** technique is used to determine the antioxidant activity of the sample. The procedure to determine the number of antioxidants is like the method of the ferrozine reagents. According to this method we take ferrozine reagent 0.01ml FeCl<sub>3</sub> with a 10:1:1 ratio. Now 0.01ml reagents was added into the 0.01 ml extract. Now 0.01ml reagents were added into the 0.01ml extract. The calibration curve is used to understand the activity of the sample. Sample blank reading for this purpose is 0.06455. [Udoh, P. et al.]

The yellow color of papaya is just due to the presence of beta carotene. Beta carotene or carotenoid can be extracted by different methods like liquid-liquid extraction, solid-phase extraction or supercritical fluid extraction. AOAC (1993) recommends methanol/tetrahydrofuran (THF)

(50:50 v/v). In early this century, scientists found that some cancers can be avoided by  $\beta$ -carotene. The major sources of  $\beta$ -carotene came from papaya. But  $\beta$ -carotene also can be found in other orange fruits such as orange and carrot. Peel and flesh of papaya containing the amount of  $\beta$ -carotene because it is orange in color [Aravind, G. et al., 2013; Balasundram, N. et al., 2006].

#### Anti-Inflammatory Activity

Enzymes such as papain and chymopapain in papaya show anti-inflammatory activity which decrease the sternness of the situations such as asthma, osteoarthritis [Maisarah, A. et al., 2014].

#### Anti-fertility Activity

The seeds of papaya also show anti-fertility activity. Extract of papaya seed treated in male albino rats which reduced the caudal ependymal and testicular sperm counts [Bjelakovic, G et al., 2007].

#### Wound Healing Activity

Papaya ethanolic and aqueous extract Enhance wound healing which produces ideal components for treating wounds. Papaya seeds and fruits were estimated for wound healing movement [Maisarah, A. M et al., 2013].






The effect of papaya leaf extracts were also observed in different rats for the evaluation of wound healing spark present in papaya leaves [Anuar, N.S et al., 2008].

#### Cosmetic and Home Remedies Effect of Papaya

Table 3 demonstrates the cosmetic and home remedies effect of papaya of C. Papaya Linn [Karunamoorthi, K. et al., 2014; Udoh, P. et al.; Boshra, V et al., 2013].

**Table 3:** Cosmetic and home remedies effect of papaya

Papaya parts	Uses
Peels of papaya	Pimples and wrinkles are removed by rubbing the white pulp of raw papaya. Acts as a good bleaching agent. Defend, soothe and moisturize the skin, when its peel is used with a little milk and honey. Papaya small pieces, soak in vinegar for several weeks.

	Eliminate the peel and acts against dandruff.
<p>Leaf of papaya</p> 	<p>Cure Acne Cure dengue fever Prevent heart burn Reduce skin problems Assist diabetes</p>
<p>Roots of Papaya</p> 	<p>A decoction is obtained by boiling the outer parts of roots used to treat dyspepsia Papaya latex contain papain has natural digestive properties fruitful for the human digestive system [ Boshra, V <i>et al.</i>, 2013]</p>
<p>Seeds of Papaya</p> 	<p>Benefited for kidney Antibacterial Help to weight loss Wrinkles treatment</p>
<p>Fruit of Papaya:</p> 	<p>Apply unripe papaya juice on affected area and used for Pimples removing Mouth ulcer Improve eyesight Maintain Nerves and worms Regular menstruation [ Karunamoorthi, K <i>et al.</i>, 2014; Udoh, P <i>et al.</i>]</p>

### Conclusion

C. Papaya Linn is a nutraceutical plant that shows medicinal and pharmacological activities. All parts of papaya show its own therapeutic values that promote human health through their pharmacological and medicinal properties against various diseases including kidney diseases, cancers, digestive colon, skin, dengue fever, and many more diseases. There is collective awareness in the use of plant extracts by means of therapeutic agents. From the literature

survey, it is found that Papaya is a potential source of anticancer, anti-diabetic, anti-inflammatory, antimicrobial activity.

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