

**BASKETFUL BENEFITS OF PAPAYA**

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\* Parle Milind, [mparle@rediffmail.com](mailto:mparle@rediffmail.com)**ABSTRACT**

Papaya (*Carica papaya* Linn) is well known for its exceptional nutritional and medicinal properties throughout the world. From the times immemorial, the whole Papaya plant including its leaves, seeds, ripe and unripe fruits and their juice is used as a traditional medicine. The fruit has a large oval shape, yellowish-green skin and yellow flesh. Nowadays, Papaya is considered as a **Nutraceutical** fruit due to its multi-faceted medicinal properties. The prominent medicinal properties of Papaya include Anti-fertility, Uterotonic, Diuretic, Anti-hypertensive, Hypolipidemic, Anti-helminthic, Wound-healing, Anti-fungal, Anti-bacterial, Anti-tumor and Free radical scavenging activities. Phytochemically, the whole plant contains enzymes (Papain), carotenoids, alkaloids, monoterpenoids, flavonoids, minerals and vitamins. In the present review article, a humble attempt is made to compile all the strange facts available about this tasty fruit. This tasty fruit of Papaya is popular among family members of all ages for the delicious dishes derived from it.

**KEYWORDS:** *Carica papaya* Linn., Papaya, Nutraceutical, Wound-healing.

**INTRODUCTION**

Papaya, a juicy and tasty fruit, belonging to family Caricaceae is scientifically known as *Carica papaya* L. It is grown in various parts of the world, including India, tropical America and Europe. Papaya tree is basically a short lived Indian tree. In the historic times, it was considered as an exotic fruit because of its buttery taste and appearance. Papaya was the first genetically modified fruit consumed by human beings for its nutritional and medicinal properties.

**BOTANICAL CLASSIFICATION OF PAPAYA**

<b>Domain</b>	Flowering plant
<b>Kingdom</b>	Plantae
<b>Subkingdom</b>	Tracheobionta
<b>Class</b>	Magnoliopsida
<b>Subclass</b>	Dilleniidae
<b>Division</b>	Magnoliophyta
<b>Superdivision</b>	Spermatophyta
<b>Phyllum</b>	Steptophyta
<b>Order</b>	Brassicales
<b>Family</b>	Caricaceae
<b>Genus</b>	<i>Carica</i>
<b>Botanical name</b>	<i>Carica Papaya</i> Linn

**CULTIVARS OF PAPAYA**

Variety	Characteristics
Kamiha	Genetically engineered fruit, well known for its round shape, carry more flesh, more resistant to viruses
Mexican red	Reddish to red-orange in color, more elongated in shape and have red flesh
Mexican yellow	Yellowish in color, have yellowish flesh
Solo	Most common variety, this variety doesn't produce any male tree, reddish-orange flesh, pear shaped
Sunrise solo	Pear-shaped fruit, smooth skin, reddish orange color, sweet, sugar content high
Sunset solo	Small to medium sized, pear-shaped, orange red skin
Vista solo	Medium to large depending on climate, high quality
Waimanalo solo (X-77)	Round fruit with neck, cavity star-shaped

**HISTORY**

Papaya is native to tropical America. It was found in Southern Mexico and throughout the Andes of South America. The Spanish carried it to Europe and the Pacific Islands. Papaya was called as the fruit of the Angles by Christopher Columbus. By the mid 17<sup>th</sup> century, Papaya was distributed pantropically. Papaya was introduced to Hawaii in 18<sup>th</sup> century, and Hawaii remains the only state in the USA to produce Papaya commercially. A small industry had developed in Florida in the first part of 20<sup>th</sup> century, but declined rapidly due to a virus *viz* Papaya-ringspot- virus that affected Papaya fruit. In fact, the recent decline of the Hawaii industry was caused primarily by the same pathogen (Papaya-

ringspot-virus) that destroyed plants in Florida. However, the disease was overcome by biotechnologists at the University of Hawaii, who inserted a gene into the 'Sunrise' cultivar that conferred protection against virus. This made Papaya the first genetically modified fruit crop used for human consumption. Since 1998, most of the Papaya acreage in Hawaii has been changed to genetically modified cultivar.

### GEOGRAPHICAL DISTRIBUTION

Cultivation of Papaya is done almost in all parts of world. It is indigenous to tropical America and cultivated on large scale, in Sri Lanka, Tanzania, India, Hawaii, Florida, Philippines, South Africa and Australia. In India, Papaya is cultivated in Maharashtra, Bengal, Bihar, Haryana, Punjab, Delhi, Andhra Pradesh and Uttar Pradesh.

### BOTANICAL DESCRIPTION

#### PLANT

Papaya plant is a large, single-stemmed herbaceous perennial tree having 20-30 ft height. The leaves are very large (up to 2 ½ ft wide), palmately lobed or deeply incised with entire margins and petioles of 1-3 ft in length. Stems are hollow, light green to tan brown in color with diameter of 8 inches and bear prominent leaf scars.

#### FRUIT

The fruits are big oval in shape and sometimes called pepo- like berries, since they resemble melon by having a central seed cavity. Fruits are borne axillary on the main stem, usually singly but sometimes in small clusters. Fruits weigh from 0.5 upto 20 lbs, and are green until ripe, turning yellow or red-orange. Flesh is yellow-orange to salmon (pinkish-orange) at maturity. The edible portion surrounds the large, central seed cavity. Individual fruits mature in 5-9 months, depending on cultivar and temperature. Plants begin bearing fruits in 6-12 months.



Fresh Papaya with Embedded Seeds

#### FLOWERS

Papaya plants are dioecious or hermaphroditic, producing only male, female or bisexual (hermaphroditic) flowers. Papayas are sometimes said to

be "trioecious" meaning that separate plants bear either male, female, or bisexual flowers. Female and bisexual flowers are waxy, ivory white, and borne on short peduncles in leaf axils along the main stem. Flowers are solitary or small cymes of 3 individuals. Ovary position is superior. Prior to opening, bisexual flowers are tubular, while female flowers are pear shaped. Since, bisexual plants produce the most desirable fruit and are self-pollinating; they are preferred over female or male plants.

A male Papaya is distinguished by the smaller flowers borne on long stalks. Female flowers of Papaya are pear shaped, when unopened whereas, bisexual flowers are cylindrical.

#### POLLINATION

Bisexual flowered plants are self-pollinating, but female plants must be cross pollinated by either bisexual or male plants.

#### PHYTOCONSTITUENTS OF PAPAYA

*Carica papaya* contains many biologically active compounds<sup>1</sup>. Two important compounds are Papain and Chymopapain, which aid in digestion. Papain is also used to treat arthritis. The concentration of the compounds varies in the fruit, latex, leaves and roots<sup>2,3</sup> (See **Table 4**). In addition, phytochemicals from male and female trees differ in the quantity of the compounds. For example, phenolic compounds tend to be higher in male trees than female trees. The quantity of fresh Papaya latex and dry latex (crude papain) varies with the sex of the tree and the age of the tree. Female and hermaphrodite trees yield cruder papain than male trees and older fruits yield more papain than younger fruits. However, the activity of the papain is higher in the extracts from the younger fruits than the older fruits. Furthermore, fresh papaya fruit contains 87.67% moisture content<sup>1</sup>.

#### PHARMACOLOGICAL ACTIVITIES

##### Anti-fertility activity

The anti-fertility effects of *Carica papaya* were investigated by feeding adult and pregnant rats with different components of the fruit. No attempt was made to force-feed the animals and the results indicated that the unripe fruit interrupted the oestrus cycle and induced abortion. This effect vanished, as the fruit became stale or over riped. Chloroform extract of *Carica papaya* seeds induced long term azoospermia in langur monkey. The extract gradually decreased the sperm concentration and sperm motility after 30-60 days of treatment. Azoospermia was observed after 90 days of treatment and continued during the whole treatment period. Treatment withdrawal resulted in a gradual recovery in these parameters and 150 days later they reverted to the

pretreatment values<sup>4</sup>. Papaya also showed the anti-implantation and abortifacient effects<sup>5</sup>.

#### **Uterotonic activity**

Papaya latex extract was tested on rat uterine preparations in vitro at various stages of the estrous cycle and gestation periods. Rat uterine contractile activity was remarkably increased by different doses of Papaya latex extract in pro-estrus and estrus stages compared to meta-estrus and di-estrus stages of the estrous cycles. The crude Papaya latex contains a uterotonic principle, comprising of a combination of enzymes, alkaloids and other substances, which evoked sustained contractions of the uterus by acting mainly on the alpha adrenergic receptor population of the uterus at different stages<sup>6</sup>.

#### **Nephro-protective activity**

The elevation in serum concentration of urea and creatinine are indicative of renal injury. Nephro-protective effect of aqueous extract of the unripe seeds of *Carica papaya* in CCl<sub>4</sub> induced renal injury in wistar rats was observed in a dose-related manner<sup>7</sup>.

#### **Anti-inflammatory activity**

Ethanollic extract of *Carica papaya* leaves showed anti-inflammatory effect on rats using carrageenan induced paw oedema, cotton pellet granuloma and formaldehyde induced arthritis models<sup>8</sup>.

#### **Anti-hypertensive activity**

Papaya leaves decoction can be used as an anti-hypertensive agent. A study on villagers of Agboville Department located at 80 km of Abidjan (West Africa), showed the hypotensive activity of Papaya plant when administered orally<sup>9</sup>.

#### **Hypoglycemic and hypolipidemic activity**

Study showed that oral treatment with 0.1 mg/kg/day of glibenclamide and 100-400 mg/kg/day of aqueous seed extract of *Carica papaya* induced significant, steady and progressive hypo-glycemic and hypo-lipidemic effect<sup>10</sup>.

#### **Anthelmintic activity**

Aqueous extract of the seeds of papaya showed anthelmintic property against *Ascaris lumbricoides* and *Ascaridia galli*<sup>11</sup>.

#### **Wound-healing activity**

Diabetic wounds are slow, non-healing wounds that can persist for weeks despite adequate and appropriate care. Such wounds are difficult and tough to manage. *Carica papaya* extract showed wound-healing properties after its topical application in streptozotocin-induced diabetic rats. The wound size reduced as early as day 5 in diabetic animals that were treated with topical mupirocin<sup>12</sup>. Another interesting investigation showed that aqueous extract of *Carica papaya* leaves had wound-healing potential in rats. Traditionally, Papaya is an herbal

treatment in developing countries for burns, soft tissue wounds and skin infection<sup>13</sup>.

#### **Anti-amoebic activity**

The seeds of Papaya demonstrated in-vitro anti-amoebic activity<sup>14</sup>.

#### **Anti-fungal activity**

*Carica papaya* seeds extract and papain enzyme possesses anti-fungal activity<sup>15</sup>.

#### **Anti-bacterial activity**

The seeds of *Carica papaya* were found to possess bacteriostatic activity against several enteropathogens such as bacillus subtilis, enterobacter cloacae, escherichia coli, salmonella typhi, staphylococcus, proteus vulgaris, pseudomonas aeruginosa and klebsiella pneumoniae. Among the gram-positive and gram-negative bacteria tested, the gram negative bacteria were more susceptible to the extracts. The fact that the extracts were active against both gram-negative and gram-positive bacteria tested indicates a broad spectrum of activity<sup>16</sup>.

#### **Anti-tumor activity**

Aqueous extract of *Carica papaya* leaf had the anti-tumor effect on the proliferative responses of solid and haematopoietic tumor cell lines. *Carica papaya* extract inhibited the proliferative responses of solid tumor cell lines derived from cervical carcinoma, breast adenocarcinoma, hepatocellular carcinoma, lung adenocarcinoma, pancreatic epithelioid carcinoma and mesothelioma in a dose-dependent manner<sup>17</sup>.

#### **Free-radical scavenging activity**

Flavonoids are the naturally occurring phenolic compounds present in Papaya and are the potent free radical scavengers<sup>18</sup>. The high potential of phenolics to scavenge free radicals may be due to many phenolic hydroxyl groups<sup>19</sup>. Aqueous extract of *Carica papaya* leaves showed anti-oxidant activity<sup>20</sup>.

#### **Anti-sickling activity**

Sickle cell disease (SCD) results from a mutation in hemoglobin inside the red blood cells, where a glutamic acid at position 6 is replaced by valine. Recent studies showed that unripe Papaya fruit extract has anti-sickling activity<sup>21</sup>. Another study showed the potent anti-sickling property of *Carica papaya* leaf extract in a dose-dependent manner<sup>22</sup>.

#### **Diuretic activity**

The roots of Papaya tree possess diuretic property<sup>23</sup>.

#### **PAPAYA: AS A FOLKLORE MEDICINE**

From the times immemorial, the whole Papaya plant including its leaves, barks, roots, ripe and unripe fruits and their juices are used as a traditional medicine (See Table 6). Papaya is a good source of vitamins A, C, E, and K, as well as folate and fibre (See Table 5). In

addition, it is fat-free, cholesterol-free and low in sodium. An average serving fruit dish (1/2 Papaya) has only 70 calories.

### SAFETY PROFILE

The available literature does not reveal any adverse/toxic effect upon consumption of Papaya fruit over a long period of time except that it causes infertility. However, the leaves and roots of *Carica papaya* contain cyanogenic glucosides, which form cyanide leading to fatal consequences.

#### STRANGE FACTS

- ❖ In some countries, tea made from Papaya leaves is consumed as a protection against malaria.
- ❖ The seeds of the fruit resemble pepper-corns and are edible. They can be used as a substitute for black pepper.
- ❖ The bark of Papaya tree is often used to make rope.
- ❖ Papaya contains latex, which can cause an allergic reaction in sensitive persons.
- ❖ Eating too much of Papaya can cause carotenemia, the yellowing of the soles of the feet and the palms. It is a temporary phenomenon and goes away once excessive amounts of Papaya are no longer being eaten.
- ❖ Papaya is a very rich source of vitamin C.

### CONCLUSION

Papaya (*Carica papaya* linn) is well known for its exceptional nutritional and medicinal properties throughout the world. The whole Papaya plant including its leaves, seeds, ripe and unripe fruits and their juice is used as a traditional medicine. Nowadays, Papaya is considered as a **Nutraceutical** fruit due to its multifarious medicinal properties. The available literature does not reveal any adverse/toxic effects upon consumption of Papaya fruit over a long period of time except that it causes infertility. Clinical trials need to be carried out to exploit the therapeutic utility of Papaya in combating various diseases.

### DISHES CONTAINING PAPAYA

- 1) Fresh fruit
- 2) Papaya juice
- 3) Papaya snacks/desserts
- 4) Soap (skin smoother)
- 5) Papaya milk shake
- 6) Papaya medicine
- 7) Pies
- 8) Jams
- 9) Jellies
- 10) Ice-creams



Indian Papaya

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**Table 1: INDIAN SYNONYMS OF CARICA PAPAYA**

Language	Region	Names
Hindi	Haryana, Delhi	Papaya, Papita
Bengali	West Bengal	Papaya, Papita, Pepe
Tamil	Tamil Nadu	Pappali
Malayalam	Kerala	Omakai
Punjabi	Punjab	Papita
Marathi	Maharashtra	Papai
Gujarati	Gujarat	Papaya
Rajasthani	Rajasthan	Eerankari
Oriya	Orrisa	Amrut bhanda
Kannada	Karnataka	Pharangi
Telugu	Andhra Pradesh	Boppayi pandu

**Table 2: INTERNATIONAL SYNONYMS OF CARICA PAPAYA**

Country	Names
U.K	Papaya, pawpaw, papaw
India	Papita
Holland	Mummy apple, tree melon
Australia	Paw paw
Brazil	Mamao
France	Papaya
Cuba	Fruta Bomba

**Table 3: DIFFERENT SPECIES OF PAPAYA**

<i>Carica baccata</i>	<i>Carica microcarpa</i>
<i>Carica candamarcensis</i> (mountain Papaya)	<i>Carica monoica</i>
<i>Carica candicans</i> (mito)	<i>Carica nana</i>
<i>Carica caudate</i>	<i>Carica omnilingua</i>
<i>Carica cauliflora</i>	<i>Carica palandensis</i>
<i>Carica cestriflora</i>	<b><i>Carica papaya</i></b>
<i>Carica chilensis</i>	<i>Carica parviflora</i>
<i>Carica crassipetala</i>	<i>Carica pentagona</i>
<i>Carica cundinamarcensis</i>	<i>Carica pubescens</i>
<i>Carica dodecaphylla</i>	<i>Carica pulchra</i>
<i>Carica glandulosa</i>	<i>Carica quercifolia</i>
<i>Carica goudotiana</i>	<i>Carica sphaerocarpa</i>
<i>Carica heterophylla</i>	<i>Carica spinosa</i>
<i>Carica horovitiana</i>	<i>Carica spruce</i>
<i>Carica longiflora</i>	<i>Carica stipulate</i>
<i>Carica Mexicana</i>	<i>Carica weberbaueri</i>

Table 4: CHEMICAL COMPOSITION OF *CARICA PAPAYA*

Sr. No.	Phytoconstituents	Plant Part
1	Enzymes: papain and chymopain, glutamine cyclotransferase, peptidase A and B and lysozymes	Unripe fruits (latex)
2	Carotenoids: $\beta$ carotene, crytoxanthin, violaxanthin, zeaxanthin	Fruits
3	Alkaloids: Carpinine, carpaine, pseudocarpaine, vitamin C and E, choline, carposide	Leaves, Heartwood
4	Monoterpenoids: 4-terpineol, linalool, linalool oxide	Fruits
5	Flavonoids: quercetin, myricetin, kaempferol	Shoots
6	Minerals: calcium, potassium, magnesium, iron, copper, zinc, manganese	Leaves, Fruits
7	Vitamins: thiamine, riboflavin, niacin, ascorbic acid, $\alpha$ -tocopherol	Shoots Leaves
8	Glucosinolates: benzyl isothiocyanate, benzylthiourea, $\beta$ -sitosterol, papaya oil, caricin and an enzyme myrosin	Seeds
9	Carposide, and an enzyme myrosin	Roots

Table 5: NUTRITIONAL FACTORS

Elements	Amount (per 100 g)
Energy	163kJ(39kCal)
Carbohydrates	9.81 g
Sugar	5.90 g
Dietary fibre	1.8 g
Fat	0.14 g
Protein	0.61 g
Vitamin A	55 $\mu$ g (6%)
Beta-carotene	276 $\mu$ g (3%)
Thiamine (Vit. B <sub>1</sub> )	0.04 mg (3%)
Riboflavin (Vit. B <sub>2</sub> )	0.05 mg (3%)
Niacin (Vit. B <sub>3</sub> )	0.338 mg (2%)
Vitamin B <sub>6</sub>	0.1 mg (8%)
Vitamin C	61.8 mg (103%)
Calcium	24 mg (2%)
Iron	0.10 mg (1%)
Magnesium	10 mg (3%)
Phosphorus	5 mg (1%)
Potassium	257 mg (5%)
Sodium	3 mg (0%)

Percentages are relative to US recommendations for adults

**Table 6: TRADITIONAL USES OF PAPAYA**

- ❖ Unripe Papaya is commonly used as a contraceptive in Pakistan, India and Sri Lanka.
- ❖ Papaya contains a natural pain reliever. Papaya paste was used for the relief of burns, cuts, rashes and stings.
- ❖ The papain's presence in Papaya makes it helpful against heartburn and indigestion. It can prevent heartburn, when mixed with a little honey and taken before meals.
- ❖ The fruit's proteolytic enzymes and other compounds, including a substance called carpaine, are effective against intestinal worms and other parasites.
- ❖ Papaya seeds reverse infertility of rats.
- ❖ Papaya latex is a very effective meat tenderizer.
- ❖ Papain has been employed to dissolve membranes in diphtheria.
- ❖ It reduces swelling, fever and adhesions after surgery.
- ❖ Chemopapain is sometimes injected in cases of slipped spinal discs or pinched nerves.
- ❖ The ripe fruit, when eaten fresh, improves digestion and is reported to have a complimentary laxative effect.
- ❖ It is used as a disinfectant and as an anti-ulcer medicine.
- ❖ It can be used in celiac disease and crohn's disease.
- ❖ Latex, the milk like juice from unripe Papaya is rich in papain. Studies showed that it helps in removing freckles (melanin clusters on face).
- ❖ The Papaya seeds are also used as vermifuges.
- ❖ Leaves are used for dressing wounds and injuries.
- ❖ Papain helps in thinning of the blood and inhibits clotting.



**Unripe (green) Papita**



**Indian Papaya Tree**