A REVIEW ON SIGNIFICANCE OF CARICA PAPAYA LINN: A PROMISING MEDICINAL PLANT

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INTRODUCTION

Nature has been considered as a source of various medicinal plants, which aids in the wide variety of human treatments. Papaya is a small evergreen tropical plant that bears papaya fruit throughout the year. Due to its medicinal properties and other nutraceutical activities, it is the most widely cultivated and best-known species. \textit{C. papaya} is a juicy and tasty fruit, belongs to the genus \textit{Carica} and family \textit{Caricaceae}, and scientifically known to be \textit{Carica papaya} Linn.

In India, it is represented by four genera and four species (Krishna \textit{et al}, 2008). It is native to Southern Mexico and is distributed in various parts of the world, like India, Europe, and tropical America. Papaya is also known as the Papaya melon tree, Papau or Pawpaw, Lapaya, Tapayas, Kapaya, and Tapayas. The plant is lactiferous as they contain specialized cells called lactifers. These lactifers contain milky sap-like latex which is dispersed throughout the plant tissues (Anur \textit{et al}, 2008). The entire plant including seeds, leaves, latex, their juice, ripe and unripe fruit has been practiced as traditional medicine.

Technically \textit{C. papaya} is a giant herb and it has been benefited as a natural herbal medicine due to its anti-amoebic, antimicrobial, Anti-fungal, anti-helminthic, hypolipidemic, Hypo protective, male infertility and female infertility (Krishna \textit{et al}, 2008). Papaya is also considered as the powerhouse of nutrients as it contains rich sources of antioxidants, Vitamin C, Vitamin A, and Vitamin E; the minerals such as potassium, magnesium, and B Vitamin pantothenic acid as well as rich folate and fiber contents.

The papaya fruit with its excellent source of beta carotene is said to be pharmacologically implemented because it prevents the damage caused by free radicals that may lead to some forms of cancerous cell. It is also reported that it aids in the prevention of diabetes and heart diseases. As it is rich in fiber, it can be a good source to lower high cholesterol level and effectively treats and improves digestive as well as abdominal discomforts. It can also be the traditional medicine for hyperacidity, dyspepsia, dysentery, and constipation. The use of papaya leaf juice is also one of the traditional methods of curing dengue fever. Scientific research and several case studies have revealed that the use of papaya leaf juice which
contains enzymes like chymopapain and papain, has boosted platelets, also known as thrombocytes (Raju and Yesuf 2010).

**Origin and History**

*C. papaya* probably has been originated in Southern Mexico and Costa Rica region and was further introduced as a plantation crop in tropical and subtropical countries. During Spanish exploration in the 16th century, it is believed that papaya seeds were carried and distributed to the Caribbean and South East Asia (Millind and Gurditta, 2011).

**Geographical Distribution**

*C. papaya* is an indigenous plant cultivated in almost all parts of the world, large scale in India, Sri Lanka, Tanzania, Florida, Philippines, South Africa, and Australia. Among these countries, India is the largest cultivar of papaya.

It survives in warm areas with adequate rainfall and temperature range for about 21-33°C. Its altitude is said to be 1600m from sea level and is like that of a banana tree.

In India, Maharashtra, Bihar, West Bengal, Haryana, Punjab, Delhi, Uttar Pradesh, and Andhra Pradesh are states involved in the cultivation of *C. papaya* plant (Millind and Gurditta, 2011).

**Taxonomy**

- **C. papaya** belonging to family *Caricaceae* has four genera in the world. *Carica* Linn, the genus is represented by four species in India, among them *Carica papaya* Linn. is best and most widely produced.
- The other species are *Caricacauliflora* Jacq., *C.pubescens* and *C. quercifola* (Krishna et al, 2008).
- **Varieties:** There are several varieties of *Carica papaya* including Kamiha, Mexican red, Mexican yellow, Solo, Sunrise solo, Sunset solo, Vista solo and Waimanalo solo (Morton et al, 1987).
- **Botanical Name:** *Carica papaya*, **Common name:** Papaw, Papapya, Kates, Pawpaw,
- **Bengali Name:** Pepe, Papeya; Koiya, **Tribal names:** Pepo, Ptega, Somphula, Cokia, Kamco.
- **Parts used:** Entire Plant–Root, Stem, Bark, Leaves, Fruits, Seed, Latex

**Botanical Classification**

- **Domain:** Flowering plant
- **Kingdom:** Plantae
- **Subkingdom:** Viridaeplantae
- **Infrakingdom:** Streptophyta
- **Division:** Tracheophyta

**Class:** Magnoliopsida
**Superorder:** Rosanne
**Order:** Brassicales
**Family:** Caricaceae
**Genus:** Carica
**Species:** *Carica papaya* L (Millind and Gurditta, 2011).

**Morphology of Carica papaya**

*C. papaya* L., the papaya is evergreen and traditional cultivated tree, which is an unbranched, small tree-like herb. The plant is a member of family *Caricaceae* which is a dual or multipurpose herbaceous crop cultivated in tropical and subtropical regions. The plant is commonly called “tree”, is properly a large herb growing up to 6-10feet i.e. 1.8-3m.

**Varieties:** Papaya plant has been identified with variety and considerable size and with quality and characteristics. The few prominent and cultivated are Solo, Kapoho Solo, Dwarf Solo, Waimanalo, Heggins, Honey Gold, Cariflora, Sunrise Solo (Morton et al, 1987).

The plant contains latex in all parts due to the presence of specialized cells called lacterifers which is responsible for the secretion of latex considerably has medicinal properties.

**Soil:** The best soil required for the growth of *C. papaya* is porous soil, which is rich with organic matter, the plant is said to grow with limestone, marl, or various other soils with adequate care. The optimum pH required is about 5.5 to 6.7.

**Climate:** Papaya grows in tropical and subtropical areas; it requires adequate temperature and plentiful rainfall or irrigation. It is very sensitive to frost and limited to the region between 32° north and 32° souths of the Equator (Morton et al, 1987).

**Flowers:** The flower of the papaya are fleshy, waxy and fragrant with 5 petalled structure. Few plants may have short-stalked pistillate flowers, with waxy nature and ivory white coloration, in some of the hermaphrodite flowers may have ivory white with bright yellow anthers.
**Seed:** The papaya seeds are round and blackish, and it measures about 0.6 cm in diameter and each seed is enclosed in a gelatinous membrane called an aril.

**Fruits:** Papaya fruits may generally melon-like or pear-shaped or pyriform or slender like structure with bright golden yellow skin coloration. The flesh of the fruit will be juicy and smooth with a sweet and sour flavor. When the fruit is green and hard it indicates the presence of rich sticky white latex in it.

**Stem:** Papaya stem possesses cylindrical with 10 to 30 cm in diameter and 5 to 10 cm at the base to crown. The stem is hollow with leaf scars and characterized by spongy fibrous tissue. It also has an extensive rooting system with a stem density of 0.13 g cm⁻³. Stem provides structural support, body mass, defense substances, storage capacity and carries water flow, nutrients and organic compounds to root and shoot.

**Roots:** The root system of papaya is characterized by the fibrous system with non-axial and composed of 1 or 2 0.5 to 1.0 m long taproots. Secondary roots are said to emerge from the upper sections and branch profusely.

**Nutritional Value**

Papaya is said to be rich in iron and calcium; a good source of vitamins A, B and an excellent source of vitamin C (ascorbic acid). Papaya contains polysaccharides, vitamins, minerals, enzymes, proteins, alkaloids glycosides, fats, and oils as well as lectins and saponins.

**Table 1** Nutritionaly important minerals in different plant parts of C. papaya ( in ppm) (Verma et al, 2014).

<table>
<thead>
<tr>
<th></th>
<th>Zn</th>
<th>Fe</th>
<th>Ca</th>
<th>K</th>
<th>Na</th>
<th>Mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root</td>
<td>23.91</td>
<td>8.14</td>
<td>186.64</td>
<td>781.44</td>
<td>63.68</td>
<td>23.16</td>
</tr>
<tr>
<td>Stem</td>
<td>31.05</td>
<td>7.73</td>
<td>262.18</td>
<td>775.12</td>
<td>87.08</td>
<td>27.71</td>
</tr>
<tr>
<td>Leaf</td>
<td>10.97</td>
<td>6.07</td>
<td>628.63</td>
<td>316.40</td>
<td>17.72</td>
<td>10.64</td>
</tr>
<tr>
<td>Fruit</td>
<td>0.28</td>
<td>2.73</td>
<td>153.91</td>
<td>711.23</td>
<td>26.31</td>
<td>0.84</td>
</tr>
<tr>
<td>Seed</td>
<td>23.91</td>
<td>8.14</td>
<td>186.64</td>
<td>781.44</td>
<td>63.68</td>
<td>23.16</td>
</tr>
</tbody>
</table>

**Chemical composition**

The chemical composition of various parts of the papaya plant varies accordingly. As it has lactiferous properties due to the presence of specialized cells that secrete latex in most of the tissues. It secretes milky material called latex which is
dispersed throughout the plant. The latex is said to be a rich source of papain, chymopapain, caricain and glycol and peptidase.

**Root:** Root contains Caproside and Myrosine enzyme

**Leaves:** Leaves composed of Vitamin C and E, Choline, caproside, Alkaloids, carpain, pseudocarpain, dehydrocarpain 1.2.

**Fruits:** Protein, fat, carbohydrates, minerals, vitamins, volatile compound, alkaloids, glycosides

**Juice:** Palmitic acid, stearic acid, linoleic oleic acid, myristic, N-butryic, n-hexanoic

**Seed:** Benzyl isothiocyanate, carpaine, Fatty acid, crude protein, crude fibers, carcin, and myrosin enzyme.

**Latex:** Papain-proteolytic enzyme, chemopapain, chymopapain A,B,C, Peptidase, and lysosome (Krishna et al, 2008).

**Biochemistry of C. papaya leaf:**
The papaya leaves contain various bioactive components that have a wide range of applications in human ailments.

**Biochemistry of C. papaya seed:**
C. papaya seeds possess main bioactive compounds that are responsible for the anthelmintic activity and Phospholipids-phosphatidylcholine, cardiolipin.

**Phyto-constituents of C. papaya**
C. papaya has been considered as a nutraceutical fruit because of its traditional medicinal properties. The entire papaya plant has a good source of phytochemical constituents like vitamins, minerals, polysaccharides, alkaloids, proteins, glycosides, fats, saponins, sterols and flavonoids (Knachik et al, 2002). Many biologically active compounds like chymopapain, papain, caricain, and glycol -endopeptidase and lipase which have importance, also been screened in papaya (Arvind et al, 2013; Chaiwaut et al, 2007).

C. papaya is recognized for its effective natural medicine treating and controlling the edema and inflammation, during surgical studies, this made possible due to the presence of main enzymes. Phenolic compounds were the major bioactive compounds that aid in human health benefits. There was a positive reaction in therapeutic effects in patients suffering from an inflammatory disorder of intestine and eye (Wimalaswansa, 1981).

Some of the important phytochemical constituents like Lycopene, Benzylisothiocyanate, Chlorogenic acid, caffeic acid, protocatechuic acid, and Quercetin. Among these more than 500 compounds from C. papaya has been said to be associated with anti-cancer activities and few bioactive compounds like Phenolic, Glucosinolate and Carotenoids have been used in anti-cancerous studies interestingly (Knachik et al, 2002).

**Table 2 Chemical constituents present in different parts of the papaya plant (Arvind et al, 2013).**

<table>
<thead>
<tr>
<th>Phytoconstituents</th>
<th>Part of plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enzyme</td>
<td>Unripe fruit</td>
</tr>
<tr>
<td>Papain, chymopapain</td>
<td>Fruits</td>
</tr>
<tr>
<td>Carotenoids</td>
<td>Roots</td>
</tr>
<tr>
<td>Carpine</td>
<td>Seeds</td>
</tr>
<tr>
<td>Carpinine</td>
<td>Shoots, leaves</td>
</tr>
<tr>
<td>Vitamin C and E</td>
<td>Leaves</td>
</tr>
<tr>
<td>Alkaloids</td>
<td>Fruits</td>
</tr>
<tr>
<td>Monoterpenoids</td>
<td>Linalool, 4-terpinol</td>
</tr>
</tbody>
</table>

**Pharmaceutical activities of Carica papaya Linn.**

**Antioxidant Activity**
The important and major group of the phytochemicals present in papaya can be considered as a natural source of antioxidants. These antioxidants when present in low concentration compared to the oxidizable substrate significantly said to delay or prevent the process of oxidation caused by free radicals. Phenols, carotenoids and traditional antioxidant vitamins C and E also contribute to antioxidant activity, which plays an important role in total antioxidant activity. Antioxidants also aid in decreasing DNA damage and also diminishing lipid peroxidation, and finally, it boosts up our body’s immune system and also functions in inhibiting the malignant transformation of cells for further damage (Saba, 2013).
**Antibacterial activity**

C. papaya has shown to exhibit antibacterial activity, i.e. papaya has a positive effect against bacterial infection (Wimalawansa, 1981). It was reported that the use of C. papaya had benefited in treating the wound hence it improved the efficiency action of phagocytic cells in destroying bacteria (Gurung et al, 2009).

The extracts of C. papaya from the skin, pulp and seeds of both ripe and unripe had potential antibacterial activity against the various bacteria including Escherichia coli, Enterobacter cloacace, Bacillus subtilis, Bacillus cereus, Proteus vulgaris Salmonella typhi, Pseudomonas aeruginosa and Shigella f /laeuxer (Yismaw et al, 2008).

The bacteriostatic activity against fewenteropathogens such as Bacillus subtilis, Enterobacter cloacace, Escherichia coli, Salmonella typhi, Staphylococcus, Proteus vulgaris, Pseudomonas aeruginosa and Klebsiella pneumonia with C. papaya seeds extracts. Among them, Gram-negative bacteria were tested to be more susceptible compared to Gram-positive bacteria (Doughari et al, 2007; Leite et al, 2005).

**Anti-helminthic activity**

Helminthiasis is a disease that is caused by worms like pinworm, roundworm, or tapeworm. These worms reside in the gastrointestinal tract and also burrows and spread into the liver, producing harmful effects on the host and causes blood loss and secretes toxins by severely damaging the organs (Millind and Guriditta, 2011).

The extracts of papaya plants including the seed extract have been used traditionally for the treatment of helminthiasis, the important and major proteolytic enzyme is considered to digest nematode cuticles. The enzymes because of its lowest toxicity have been traditionally used as medicine to treat gastrointestinal discomforts caused by nematodes (Subenthriran et al, 2013).

The Aqueous extracts of seeds from papaya significantly showed anti-helminthic activity against helminths such as Ascaris lumbricoides and Ascaris diagalli (Akhtar et al, 2000).

**Anti-inflammatory activity**

The major proteolytic enzymes such as papain and chymopapain and also antioxidant nutrients from papaya with Vitamin C, E, and Beta carotene has significantly reduced the severity conditions of asthma, osteoarthritis and rheumatoid arthritis (Arvind et al, 2013).

The reaction of living cells or tissue to injury or infection/irritation/infiltration is said to be process Inflammation. By the release of inflammatory mediators like cytokines, leukotrienes, histamines, prostaglandins, serotonin, and nitric oxide the process of inflammation could be induced. The best and cheap source for treating such a process is bynatural medicinal plants, which possess therapeutic efficacy and also have less or no side effects (Amazu et al, 2010).

**Anti-Dengue Activity**

The study which was conducted to investigate the increasing property of platelet by use of C.papaya leaves juice have proved the significant rise of platelet in an observed group. The compilation of platelet count between two groups that is control and intervention group after administration of CDLJ for about 40-48 hours was conducted and interestingly, there was significantly higher in the intervention group compared to the control group increase. Hence, the CPLJ has significantly accelerated the increase platelet count of patients suffering from Dengue fever and Dengue hemorrhagic fever (Subenthiran et al, 2013).

**Antifertility Activity**

The study investigated the effects of antifertility using C. papaya by feeding adult and pregnant with various components of fruits reveals that unripe n fruit interrupted the oestrous cycle and induced abortion. Another study also revealed that chloroform extract of papaya seeds also induced long term azoospermia in languor monkey (Lohiya et al, 2000). Hence papaya has said to be used as anti-implantation and abortifacient effect (Poharkat et al, 2010).

**Anti-sickling Activity**

Sickel cell disease (SCD) is characterized by the mutation in hemoglobin which results in the action of replacing the glutamic acid of the 6th position is replaced by valine. Studies regarding the use of unripe fruit of C. papaya extracts have proven the anti-sickling activity (Oduola et al, 1949; Imago et al, 2009).

**Anticancer Activity**

The unique structure of enzyme papain which is a good source of C. papaya has proved effective properties against the cancerous cell. As cancerous cell possess a protective coating of fibrin which remains to be undetected for about a long period. The papain, which is an endolytic enzyme, isolated from papaya cleaves peptide bonds and helps in breaking down the fiber coated over cancerous cell wall and helps against recognizing the cancer cell (Abu et al, 2009; Mitchel et al, 1970).

Papaya is referred to as a Storehouse of cancer-fighting lycopene. As lycopene is a member of the carotenoid family, that helps in fighting with cancerous cells. Lycopene with unsaturated open straight hydrogen compound which contains 11 conjugated and 2 unconjugated double bonds (Knachik et al, 2002; Rao et al, 2006). Hence, it enhances the cell to cell communication by increasing Gap junctions (Gali and Bakkar, 2002).

**DISCUSSION**

Papaya, popularly known as the king of medicine is loaded with an enormous amount of important nutrients. It is also referred to as “Powerhouse of nutrients” because of its diversity of compounds and phytoconstituents and antioxidants present in it. Papaya is considered to be the first genetically modified fruit for human consumption. Varisou xtracts of different parts of C. papaya plant have revealed the protective effects against infection, antiseptic, antiparasitic and antibacterial activity. Several important phytochemicals and with the presence of an important endolytic enzyme called papain plays a potential role against the cancerous cell. Papaya is not only with tastier or juicy fruit but also rich in vitamins, minerals, and antioxidants which is traditionally used to treat various health ailments.
CONCLUSION

The present review which mainly focused on finding the secrets behind papaya reveals, the importance of using C. papaya is traditional medicine and a natural promising herb. As traditional medicine is considered as an inspiration, the application of natural products has been interestingly increasing for therapeutic purposes. The papaya plant with its enormous nutritional and pharmaceutical has great potential medicinal properties. The entire plant with the presence of vitamins, minerals phytochemicals and antioxidants have more application in Pharmaceutical industries and consumption of papaya serves in improving our immune system and helps to lead a healthy lifestyle.

References


