



## PHARMACOGNOSTICAL AND PHARMACOLOGICAL PROFILE OF CARICA PAPAYA – A REVIEW

G. Sindhu\*, G. Ragini, L. Sreehari, G. Gayathri, A. Thejaswee, Sk. Inthiyaz,  
T. Usha Kiran Reddy and K. Thyagaraju

SVU College of Pharmaceutical Sciences, S.V University, Tirupati.

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**\*Corresponding Author.**

**Dr. G. Sindhu**

SVU College of  
Pharmaceutical Sciences,  
S.V University, Tirupati.

### ABSTRACT

*Carica papaya*, is a lozenge tropical fruit, often seen in yellow-green and yellow-orange hues, with a rich orange pulp. The fruit is not just delicious and healthy, but whole plant parts, fruit, roots, bark, peel, seeds and pulp are also known to have medicinal properties. Most of the benefits of papaya owed due to high content of Vitamins A, B and C, proteolytic enzymes like papain and chymopapain which have antiviral, antifungal and antibacterial properties. Nowadays, Papaya is considered as nutraceutical fruit due to its multifaceted medicinal properties which include anti-fertility, diuretic, uretonic, anti-hypertensive, hypolipidemic, anti-helminthic, wound healing, anti-

fungal, antibacterial, anti tumor and free radical scavenging activities. Phytochemically, the whole plant contains enzymes, lycopene, carotenoids, alkaloids, monoterpenoids, flavonoids, minerals and vitamins. In the present review, an attempt is made to compile all the strange facts available about this tasty fruit.

**KEYWORDS:** *Carica papaya*, nutraceutical, papain, chymopapain, uretonic, hypolipidemic, antitumor, anti-helminthic, anti-hypertensive, diuretic.

### INTRODUCTION

*Carica papaya* Linn belonging to family Caricaceae is commonly known as papaya in English, Papita in Hindi and Erandakarkati in Sanskrit. The plant is native to tropical America and was introduced to India in 16th century. *Carica papaya* is regarded as nutraceutical as it is a rich source of three powerful antioxidants vitamin C, vitamin A and vitamin E; and the minerals like magnesium and potassium; the B vitamin- pantothenic acid, folate and fiber. In addition to this, it contains a digestive enzyme-papaintha which

effectively treats causes of trauma, allergies and injuries. All the nutrients of papaya as a whole improve cardiovascular system, protect against heart diseases, heart attacks, strokes and prevent colon cancer.

The fruit is an excellent source of  $\beta$ -carotene that prevents damage caused by free radicals that may cause some forms of cancer. It is reported that it helps in the prevention of diabetic heart disease. Papaya lowers high cholesterol levels as it is a good source of fiber.<sup>[1]</sup> The fruit is regarded as a remedy for abdominal disorders, the skin of papaya works as a best medicine for wounds. The enzymes papain, chymopapain and antioxidant nutrients found in papaya have been found helpful in lowering inflammation and healing burns. Hence people with diseases (such as asthma, rheumatoid arthritis, and osteoarthritis) that are worsened by inflammation, find relief by severity of the condition as it reduces after taking all these nutrients.

Papaya contributes to a healthy immune system by increasing your resistance to cough and cold because of its vitamin A and C contents. Papaya included in your diet ensures a good supply of vitamin A and C that are highly essential for maintaining a good health. *Carica papaya* constituents exhibit alkaline combination, as with borax or potassium carbonate and they have showed good results in treatment of warts, corns, sinuses, eczema, cutaneous tubercles and other hardness of the skin, and also injected into indolent glandular tumors to promote their absorption. Green fruits of papaya are used to treat high blood pressure, dyspepsia, constipation, amenorrhoea, general debility, expel worms and stimulate reproductive organs. Papaya was the first genetically modified fruit consumed by human beings for its nutritional and medicinal properties.<sup>[2]</sup>

### **Origin and Distribution**

The origin of *Carica papaya* is in Tropical America. Its seeds were distributed from the Caribbean to Malacca and India by travellers and botanists in the eighteenth century. The distribution was continued throughout Asia and Pacific. *Carica papaya* is grown in all tropical countries and many subtropical countries between 32 °North & South latitudes but the high commercial production is found in between 23 °N and S latitudes (Nakasone & Paull 1998).

**TAXONOMY, CLASSIFICATION & DESCRIPTION****Botanical Classification**

Domain	Flowering plant
Kingdom	Plantae
Sub kingdom	Tracheobionta
Class	Magnoliopsida
Sub class	Dilleniidae
Super division	Spermatophyte
Phylum	Steptophyta
Order	Brassicales
Family	Caricaceae
Genus	Carica
Botanical name	Carica papaya Linn <sup>[3]</sup>

**Synonyms of *Carica papaya* Linn**

Indian and International synonyms of *Carica papaya* Linn and different species of *Carica papaya* Linn.

**Indian Synonyms of *Carica papaya* Linn<sup>[4]</sup>**

LANGUAGE	REGION	NAMES
1. Hindi	Haryana, Delhi	Papaya, papita
2. Telugu	Andhra pradhesh, Telangana	Boppayi
3. Malayalam	Kerala	Omakai
4. Punjabi	Punjab	Papita
5. Marathi	Maharashtra	Papai
6. Tamil	Tamilnadu	Pappali
7. Gujarati	Gujarat	Papaya
8. Kannada	Karnataka	Pharangi
9. Rajasthani	Rajasthan	Eerankari
10. Bengali	West Bengal	Papaya, pepe, papita

**International Synonym of *Carica papaya* Linn<sup>[4]</sup>**

COUNTRY	NAMES
1. India	Papita
2. Holland	Tree melon
3. France	Papaya
4. Australia	Paw paw
5. Brazil	Mamao
6. UK	Papaya, Paw paw

**Different species of *Carica papaya* Linn<sup>[4]</sup>**

<i>Carica candamarcensis</i>	<i>Carica monoica</i>
<i>Carica Mexicana</i>	<i>Carica weberbaueri</i>
<i>Carica caudate</i>	<i>Carica omnilingua</i>
<i>Carica cauliflora</i>	<i>Carica palandesis</i>
<i>Carica chilensis</i>	<i>Carica parviflora</i>
<i>Carica horovitziana</i>	<i>Carica spruce</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 candicans</i>	<i>Carica nana</i>
<i>Carica longiflora</i>	<i>Carica stipulate</i>
<i>Carica crassipetala</i>	<i>Carica pentagona</i>

**Plant**

Papaya plant is a large, single-stemmed herbaceous perennial tree having 5 to 10 m (16 to 33 ft) tall (Fig. 1). The leaves are very large (upto 2½ feet wide), palmately lobed or deeply incised with entire margins and petioles of 1-3 feet in length. Stems are hollow, light green to tan brown in color with diameter of 8 inches and bear prominent scars.



**Fig.1: *Carica papaya* plant.**

The tree is unusually un-branched, unless lopped. The flowers appear on the axils on the leaves, maturing into large fruit.

**Fruit**

The fruits are big oval in shape and sometimes called pepo- like berries, since they resemble melon by having a central seed cavity (Fig. 2).



**Fig.2 Fruits of *Carica papaya*.**

Fruits are born axillary on the main stem, usually single but sometimes in small clusters. Fruits weigh from 0.5 to 20 lbs, and are green unlike ripe, turning yellow or red orange.<sup>[5]</sup> 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 cultivator and temperature. Plants begin bearing fruits in 6-12 months.<sup>[6]</sup>

### **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 (Fig. 3). 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.



**Fig.3 flowers of *carica papaya*.**

A male papaya is distinguished by the smaller flowers borne on long stalks. Female flowers of papaya were pear shaped, when unopened whereas, bisexual flowers are cylindrical.<sup>[6]</sup>

### **Pollination of *Carica papaya* Linn**

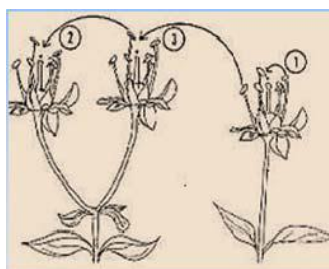
The pollination mechanism of the plant is not very well known but researchers 'Baker' and 'Bawa' suggested that "pollination is performed by mimicry of the pistillate flowers to the

staminate nectar-producing flowers." Another theory is that oxalate packages in the anthers of the papaya play a role in pollination as an enrichment of the nectar.

Three methods of pollen transfer: -

- (1) Self-pollination
- (2) Pollen from same plant but different flower
- (3) Pollen from different plant (Fig.4).

Bisexual flowered plants are self-pollinating, but female plants must be cross pollinated.



**Fig.4 Pollination in *Carica papaya*.**

### **Importance**

Papaya is mainly cultivated for its edible fruits as a fresh fruit and for use of drinks, jams, candies and dried fruit. Ripe fruits are usually eaten fresh and green fruits are also used as a cooked vegetable. Papaya also has several industrial uses. Biochemically, its leaves and fruits produce several proteins and alkaloids with important medical and industrial application.

The latex of green fruits contain a proteolytic enzyme, papain, used in the beverages, food and pharmaceutical industries for production of chewing gum, chill-proofing beer, tenderising meat, treat digestive disorders, degum natural silk, extracted fish oil. It is also used in the cosmetic industry in soap, shampoo and face lifting preparations. Evolutionary, papain may be associated with protection from frugivorous predators and herbivores (Australian Government, Department of Health and Ageing, 2003).

Whatever the case, we do know that the fruit is of great economic importance to tropical America where it is widely grown for its luscious fruit. The fruit which is orange-yellow when ripen, is a popular breakfast staple that is also used in jellies, preserves, fruit juices and as a beverage in certain Latin countries. In addition, the leaves and root of the plant are also used in a variety of dishes. The bark can also be used for rope making and the leaves as a soap substitute, is an excellent stain remover. Finally, in Java, even the flowers are eaten.

**Nutrient contents of the papaya**

Papaya is a major fruit crop worldwide that is primarily consumed as fresh fruit. Papaya fruits consist mostly of water and carbohydrate, low in calories and rich in natural vitamins and minerals, particularly in vitamins A, vitamin C, and potassium.

**Nutritional value<sup>[5]</sup> per 100 g (3.5 oz)**

**Energy** 179 kJ (43 kcal)

CONSTITUENTS	RIPE PAPAYA	GREEN PAPAYA
Water	89.1 gm	92.6 gm
Proteins	8.26 gm	10.8 gm
Total lipid	0.93 gm	1.35 gm
Ash	4.59 gm	6.76 gm
Carbohydrate	86.2 gm	81.1 gm
Total DF	11.9 gm	27.0 gm

**MINERAL MACRONUTRIENTS**

Sodium	128.4 mg	283.8 mg
Potassium	1238 mg	2743 mg
Magnesium	229.4 mg	635.1 mg
Phosphorus	NR	NR
Calcium	146.8 mg	432.4 mg

**MICRONUTRIENTS**

Iron	12.84 mg	8.11 mg
Copper	0.18 mg	0.14 mg
Zinc	0.92 mg	0
Manganese	NR	NR
Selenium	NR	NR

**VITAMINS**

Vitamin	568.8 mg	391.9 mg
Riboflavin	0.28 mg	26 mg
Niacin	2.80 mg	4.05 mg
Pantothenic acid	NR	NR
Vitamin B 6	NR	NR
Folate	NR	NR
Vitamin B 12	NR	NR
Vitamin A	NR	NR
Vitamin E	NR	NR
Vitamin K	NR	NR
Carotene	7807 ug	0
Cryptoxanthin	NR	NR
Lutein + Zeaxanthin	NR	NR

### Phyto-constituents of Papaya

Papaya fruit is highly appreciated worldwide for its flavour, nutritional qualities and digestive properties.<sup>[7]</sup> When unripe, it contains the enzyme papain (EC3.4.22.2), a cysteine protease with action similar to that of the pepsin in gastric juice. The latex, which contains papain, is harvested from unripe fruit by making incision in the fruit surface during a 4-5 day period and collecting the latex until it stops flowing. The greener the fruit, more active is the papain. Three other cysteine proteases have been isolated from papaya latex: chymopapain (EC 3.4.22.6); caricain (EC 3.4.22.30) and papaya protease IV (EC 3.4.22.25).<sup>[8]</sup> These have been purified and biochemically characterized.<sup>[9]</sup>

### Papain

It belongs to the papain superfamily, as a proteolytic enzyme, papain is of critical importance in many vital biological processes in all living organisms. Papain shows extensive proteolytic activity towards proteins, short chain polypeptides, amino acid ester and amide links and is applied extensively in the fields of food and medicine. It preferentially cleaves peptide bonds involving basic amino acids.<sup>[8]</sup> Papain is a single chain globular protein with molecular weight of 23406 DA and consists of 212 amino acids with four disulphide bridges. It is stable and active under a wide range of conditions even at elevated temperatures.<sup>[10]</sup>

### Chemical constituents

#### Fruits

Protein, fat, fibre, carbohydrates, minerals like calcium, phosphorous, iron, vitamin C, thiamine, riboflavin, niacin, and carotene, amino acids, citric and malic acids (green fruits), volatile compounds like linalool, benzyl isothiocyanate, cis and trans 2, 6-dimethyl-3,6 epoxy-7 octen-2-ol, Alkaloid,  $\alpha$ ; carpaine, benzyl- $\beta$ -D glucoside, 2-phenylethyl - $\beta$ -D-glucoside, 4-hydroxy-phenyl-2 ethyl- $\beta$ -D-glucoside and four isomeric malonated benzyl- $\beta$ -D-glucosides.<sup>[11,12]</sup>

#### Juice

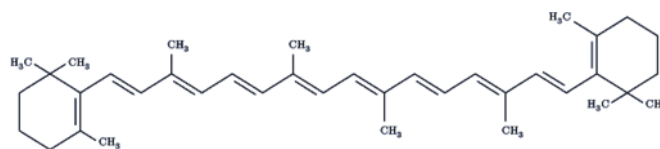
N-butyric, n-hexanoic and n-octanoic acids, lipids, myristic, palmitic, stearic, linoleic, linolenic and cis-vaccenic and oleic acids.<sup>[12]</sup>

#### Seed

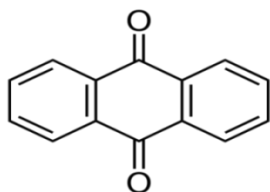
Fatty acids, crude protein, crude fibre, papaya oil, sinigrin, Carpaine, benzylisothiocyanate, benzyl glucosinolate, glucotropacolin, benzylthiourea, hentriacontane,  $\beta$ -sitosterol, caricin



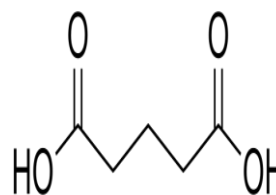
and an enzyme myrosin, leaves related alkaloids, flavonoids, saponins, tannins, cardiac glycosides, anthraquinones and cardinolodes are present.<sup>[12]</sup>



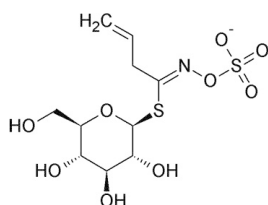
**Beta carotene**



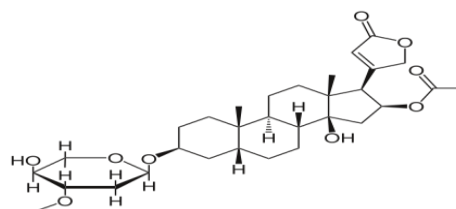
**Anthraquinone**



**glutaric acid**



**Sinigrin**



**Cardiac glycoside**

### Root

Carposide and enzyme myrosin.

### Leaves

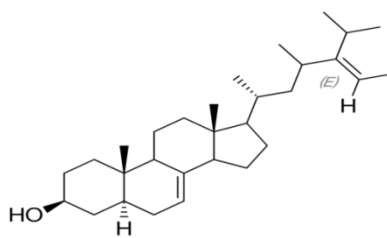
Alkaloids carpain, pseudocarpain and dehydrocarpaine I and II, choline, carposide, vitamin C and E.

### Bark

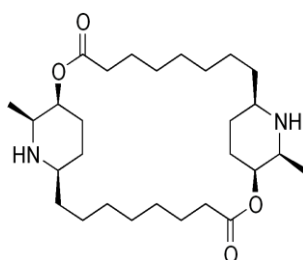
$\beta$ -Sitosterol, glucose, fructose, sucrose, galactose and xylitol.

### Latex

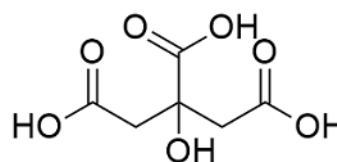
Proteolytic enzymes, papain and chemopapain, glutamine cyclotransferase, chymopapains A, B and C, peptidase A and B and lysozymes.<sup>[12]</sup>



Avenasterol



Carpaine



Citric acid

## PHARMACOLOGICAL ACTIVITY OF EACH DIVISION OF *CARICA PAPAYA*:

Whole *Carica papaya* has a unique pharmacological uses.

### LEAVES

Papaya leaf has versatile benefits. In some parts of Asia, the young leaves of the papaya are steamed and eaten like spinach.

#### a. Dengue fever

Commencing on studies of Dr.Sanath Hettige, who conducted the research on 70 dengue fever patients, said papaya leaf juice helps increase white blood cells and platelets, normalizes clotting, and repairs the liver.

#### b. Cancer cell growth inhibition

Recent research on papaya leaf tea extract has demonstrated cancer cell growth inhibition. It appears to boost the production of key signalling molecules called Th1-type cytokines, which help regulate the immune system.<sup>[17]</sup>

#### c. Antimalarial and antiplasmodial activity

Papaya leaves are made into tea as a treatment for malaria.<sup>[15]</sup> Antimalarial and antiplasmodial activity has been noted in some preparations of the plant,<sup>[15]</sup> but the mechanism is not understood and not scientifically proven.

**d. Antihypertensive activity**

Papaya leaves decoction can be used as an anti-hypertensive agent. A study on villagers of Agboville located at 80 km of Abidjan (West Africa) showed the hypotensive activity of papaya plant when administered orally.<sup>[31]</sup>

**e. Facilitate digestion:**

The leaves of the papaya plant contain chemical compounds of carpain, Substance which kills microorganisms that often interfere with the digestive function.

Additional Benefits of Papaya Leaves: As an acne medicine, increase appetite, ease menstrual pain, Meat tenderizer, and Relieve nausea.<sup>[13]</sup>

**Additional benefits of carica papaya**

- As an acne medicine
- Increase appetite
- Ease menstrual pain
- Meat tenderizer
- Relieve nausea

**Fruit**

Papaya fruit is a rich source of nutrients such as provitamin A carotenoids, vitamin C, B vitamins, lycopene, dietary minerals and dietary fibre. Danielone is a phytoalexin found in the papaya fruit. This compound showed high antifungal activity against *Colletotrichum gloeosporioides*, a pathogenic fungus of papaya.

**a. Laxative**

Ripe papaya fruit is laxative which assures of regular bowel movement.

**b. Indigestion**

The milky juice which is tapped from the green, mature fruit while still in the tree contains an enzyme known as "papain". People use this in the preparation of different remedies for indigestion.

**c. Void the heart attack or stroke**

The folic acid found in papayas is needed for the conversion of homocysteine into amino acids such as cysteine or methionine. If unconverted, homocysteine can directly damage blood vessel walls, is considered a significant risk factor for a heart attack or stroke.<sup>[13]</sup>

**d. Antioxidant activity**

The methanolic extract of unripe fruits of *C. Papaya* was evaluated for its effect on activities of antioxidant enzymes which includes glutathione peroxidase (GPx), glutathione transferase (GST), glutathione catalase and glucose-6-phosphate dehydrogenase in mice treated with an oral dose of 100mg/kg. There is significant increase of the activities glutathione reductase, GST, GPx, glucose-6-phosphate dehydrogenase due to the ethyl acetate fraction. It was suggested that quercetin and  $\beta$ -sitosterol may be responsible for antioxidant activity.<sup>[14]</sup>

**Seeds**

The black seeds of the papaya are edible and have a sharp, spicy taste. They are sometimes ground and used as a substitute for black pepper.

**a. Nephro-protective activity**

In wistar rats, nephro-protective activity was observed in dose related manner. Concentration of urine and creatinine were evaluated.<sup>[16]</sup>

**b. More potent**

The papaya seeds are very pungent and peppery, making them almost unpalatable. However the seeds seem to have more potent medicinal values than the flesh.

- Papaya seeds have antibacterial properties and are effective against *E.coli*, *Salmonella* and *Staphylococcus* infections.
- Papaya seeds may protect the kidneys from toxin induced kidney failure.
- Papaya seeds can eliminate intestinal parasites.
- Papaya seeds help detoxify the liver
- As a skin irritant to lower fever
- Cure for piles and typhoid
- Anti-helminthic and anti-amoebic properties.

Dried papaya seeds actually look quite similar to peppercorns and can be used in just the same way. Grinding a couple over a meal, especially protein rich meals, is a simple way to add extra enzymes to your diet and improve your digestive health.<sup>[13]</sup>

#### **ANTIHELMENTHIC ACTIVITY**

A wide range of plants and plant extracts has been used traditionally for the treatment of helminthes infections including papaya, which is rich in proteolytic enzymes known to digest nematode cuticles, have low toxicity and have been used in traditional medicine against gastrointestinal nematodes for decades.<sup>[18]</sup> In 1940, the worm digesting activity of a preparation of papain from *C.papaya* latex was described as they rapidly digest the ascaris cuticle.

#### **ANTI-AMOEBIC ACTIVITY**

The cold macerated aqueous extract of matured papaya seeds has shown anti-amoebic activity against *Entamoeba histolytica*.<sup>[19, 20]</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*, *proteas vulgaris*, *pseudomonas aeruginosa* and *klebsiella pneumonia*. Among the gram-positive and gram-negative bacteria tested the gram negative bacteria were more susceptible to the extract.<sup>[28, 29, and 30]</sup>

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

Study show 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 hypoglycemic and hypo-lipidemic effect.<sup>[32]</sup>

#### **PEEL**

Papaya peel is often used in cosmetics. The papaya peel can also be used in many home remedies.

##### **a. Sunscreen and smoothening shave**

The presence of vitamin A helps to restore and rebuild damaged skin. Applied papaya peel used as skin lightening agent. When peel mixed with honey and applied it can act as soothe and moisturizers the skin.

**b. Fight dandruff**

The papaya vinegar along with lemon juice can be applied to the scalp for 20 minutes prior to shampooing to fight dandruff.

**c. Muscle relaxation**

Adding papaya oil and vinegar to bath water, along with essential oils like lavender, orange and rosemary can be nourishing, refreshing and relaxing, and can work as a pain reliever and muscle relaxant.<sup>[13]</sup>

**ROOTS**

Juice from papaya roots is used in some countries of Asia to ease urinary troubles. Papaya leaf when dried and cured like a cigar is smoked by asthmatic persons. An infusion of fresh papaya leaves is used by person to expel or destroy intestinal worms. Fresh young papaya are also used to remedy colic, a certain stomach disorder or cramp. A decoction formed by boiling the outer part of the roots of the papaya tree in the cure of dyspepsia.<sup>[13]</sup>

**LATEX**

The milky sap of an unripe papaya contains Papain and chymopapain. Chymopapain was approved for intradiscal injection in patients with documented herniated lumbar intervertebra discs and who had not responded to "conservative therapy". Vitamins and traces of an alkaloid called Carpaine have also been found in the latex.

Apart from natural oils, the seeds of the fruit also contain carbohydrates, carbasemine, benzyl senevol and a glucoside. Papain is also used to treat commercial beer, to degumm natural silk, as a meat tenderizer and in the production of chewing gums. Cosmetically it is used in Shampoos and in a number of face-lifting operations. In humans capaine slows down the heart and thus reduces blood pressure.<sup>[13]</sup>

**MEDICINAL VALUE****a. Colon cancer**

The fiber of papaya is able to bind cancer-causing toxins in the colon and keep them away from the healthy colon cells. These nutrients provide synergistic protection for colon cells from free radical damage to their DNA.

**b. Anti-inflammatory effects**

Protein enzymes including papain and chymopapain and antioxidant nutrients found in papaya; including vitamin C, vitamins E, and beta-carotene, reduce the severity of the conditions such as asthma, osteoarthritis, and rheumatoid arthritis. The anti-inflammatory property of plant cysteine proteinases were already noted in literature. In a clinical study, the histological severity of inflammatory bowel disease was determined for treatment of chronic inflammatory and related diseases papain has found to be safe and efficacious.<sup>[21]</sup> Anti-inflammatory activity of papaya seeds were also reported.<sup>[22]</sup>

**c. Rheumatoid arthritis**

Vitamin C-rich foods, such as papaya, provide humans with protection against inflammatory polyarthritis, a form of rheumatoid arthritis involving two or more joints.

**d. Promote lung health:**

Eating vitamin A rich foods, such as papaya, help your lung healthy and save your life.

**e. Anti-sickling activity**

Sickle cell disease (SCD) results from a mutation in hemoglobin inside the red blood cells, where a glutamic acid at 6th position is replaced by valine. Recent studies showed that unripe papaya fruit extract has anti-sickling activity.<sup>[23]</sup> Another study showed the potent anti-sickling property of *Carica papaya* leaf extract in a dose- dependent manner.<sup>[24]</sup> Aqueous root extract of papaya when given orally at a dose of 10 mg/kg to rats produces significant increase in urine output and shows similar profiles of urinary electrolyte excretion to that of hydrochlorothiazide.

**f. Prevent prostate cancer**

Men consuming lycopene-rich fruits and vegetables such as papaya, tomatoes, apricots, pink grapefruit, watermelon, and guava were 82% less likely to have prostate cancer compared to those consuming the least lycopene-rich foods.

**g. Anticoagulant activity**

Injection of papain extract in a dog increases prothrombin and coagulation threefold. It is also claimed that the enzyme eliminates necrotic tissues in chronic wounds, burns and ulcers. Papain is also of commercial importance in the brewery industry, in the food industry and in the textile industry.<sup>[13]</sup>

#### **h. Antifungal activity**

The latex of papaya and fluconazole has synergistic action on the inhibition of *Candida albicans* growth.<sup>[24]</sup> This synergistic effect results in partial cell wall degradation due to lack of polysaccharides constituents in the outermost layers of fungal cell wall and release of cell debris into the cell culture. Latex proteins appear to be responsible for antifungal action and minimum protein concentration for producing a complete inhibition was reported as about 138 mg/dl.<sup>[25]</sup>

#### **ANTIFERTILITY ACTIVITY**

The anti-fertility effects of *Carica papaya* were investigated by feeding adult and pregnant rat with different components of the fruit. No attempt was made to force feed the animal and the result indicated that the unripe fruit interrupted the estrous 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 languor monkey.<sup>[26]</sup> Papaya also showed the anti-implantation and abortifacient effect.<sup>[27]</sup>

#### **ALLERGIES AND SIDE EFFECTS**

Papaya is frequently used as a hair conditioner, but should be used in small amounts. Papaya releases a latex fluid when not quite ripe, which can cause irritation and provoke allergic reaction in some people.

The latex concentration of unripe papayas is speculated to cause uterine contractions, which may lead to a miscarriage. Papaya seed extracts in large doses have a contraceptive effect on rats and monkeys, but in small doses have no effect on the unborn animals. Excessive consumption of papaya can cause carotenemia, the yellowing of soles and palms, which is otherwise harmless. However, a very large dose would need to be consumed; papaya contains about 6% of the level of beta carotene found in carrots (the most common cause of carotenemia).

- **Toxicity**

Externally the papaya latex is an irritant to the skin and internally it causes severe gastritis. Some people are allergic to various parts of the fruit and even the enzyme papain has its negative properties.



- **Skin discolouration**

Eating too much of a yellow, green or orange coloured food that contains beta carotene can cause a benign form of skin discoloration called carotenemia. The palms of the hands and soles of the feet are the most visible areas of the body affected by carotenemia.

- **Free Radical Scavenging Activity**

Papaya has many phenolic groups which may scavenge free radicals. Aqueous extract of papaya leaves shows anti-oxidant activity.

- **Respiratory Distress**

Papain is also a potential allergen, according to Purdue University, people who eat too much papaya and ingest high levels of papain may develop symptoms consistent with hay fever or asthma, including wheezing, breathing difficulties and nasal congestion.

- **Gastrointestinal symptoms:**

Ironically, the same papain that calms your stomach can cause an upset stomach when taken in large amounts. The high fiber content of papaya can also contribute to unrest of the digestive system. The latex of the fruit's skin can also cause irritation of the stomach.

- **Cosmetic Benefits of Papaya**

Rubbing the white pulp of raw papaya improves pimples as well as wrinkles. Papaya Works as a good bleaching agent. It is an important ingredient in bath soaps, astringents, detergent bars and hand washes. Home Recipe for Papaya Skin Lightener Experts suggests that papaya can help in removing dead worn-out skin cells and replace it with healthy new cells, thereby lightening the colour of our skin. For this, one can prepare a paste of raw papaya and apply it on the skin once for few days.

## CONCLUSION

Papaya plant is mainly used as the food ingredient throughout the world because of its fruits and its nutritive values. From the above studies about the papaya plant shows that the plant's leaves, stem, fruits and seeds also contains different chemical constituents such as Alkaloids carpain, pseudocarpain, dehydrocarpaine I and II, choline, carposide, an enzyme myrosin, vitamins A and E, sinigrin, carpaine, benzylisothiocyanate, benzyl glucosinolate, glucotropacolin, benzyl thiourea, hentriacontane,  $\beta$ -sitosterol, caricin, leaves related alkaloids, flavonoids, saponins, tannins, cardiac glycoside, anthraquinones and cardinolodes

etc. Many of the pharmacological activities have been done on the papaya plants. Hence extensive investigations on its pharmacodynamics, kinetics, proper standardization and clinical trials are needed to exploit their therapeutics utility to cure many diseases.

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