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Carica papaya Linn.: A Review on Nutritional and Medicinal Value of Papaya

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Abstract

Papaya (Carica papaya Linn.) is a popular fruit tree in the tropical part of the world. It is a delicious, sweet fruit with a pleasant aroma. The papaya is consumed worldwide as a fresh fruit and vegetable. which is healthy for humans because all parts of the plant, including fruit, stem, bark, peel, fruit, seeds, and pulp, have medicinal properties. Papaya also has nutritional value and is also used as supplements because they contain various type of vitamins like vitamin A, B and C. The richest producers of Carica papaya are India and Brazil, which produce 50% of the whole production around the world. It also contains enzymes, such as papain and chymopapain that show various pharmacological activity, such as antifungal, antibacterial, anti-inflammatory, anti-helminthic, anti-allergic, ulcer protective, and some other activities. Both the ripe and green papaya have nutritional as well as medicinal values, which are used for the treatment of numerous health issues and to control them. As an anti-hypertensive drug, green papaya fruit is used to overcome the mean arterial blood pressure, whereas quercetin is used as an antioxidant. The aqueous extract is helpful for wound contraction and is anti-amoebic and antimalarial. It is used to treat hepatotoxicity, and the extract is valuable as a diuretic. The enzymes belong to the papaya family and are used as anti-inflammatory, along with antifungal agents. The crude extract has histaminergic properties, while the extract of bark is used as an anti-fertility compound. The latex of the papaya plant is used as a hepatotoxic product. The extract of the seed is used as an immunomodulatory agent.

Keywords: Papain, *Carica papaya*, nutritional value, medicinal value, chymopapain

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INTRODUCTION

It is recorded in numerous pharmacopoeias that herbal medicines are most popular around the world. The herbal product shows safety in comparison to the other chemical or synthetic compounds. Papaya *(Carica papaya L.)* belongs to the family *Caricaceae*. It is a tropical fruit native to South America and has been used as ayurvedic medicine to provide relief from many abnormalities of the human body for a long time. It is commonly known as Papita in Hindi and Erandakarkati in Sanskrit. The word papaya originated from the Spanish word “Arawak papaya”. According to the reports, it was first cultivated in Mexico, but now, it is cultivated in various tropical countries [1]. Around the world, the total annual production of papaya fruit is 13,158,575 tonnes. The current largest producer of papaya is India, having 5,699,000 tonnes produced annually. Brazil is the second highest produced country for papaya fruit production with 1,424,650 tonnes annual. Both

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Brazil and India produce around 50% of the total papaya fruit in the world [2]. Papaya is also known as the powerhouse of nutrients due to its richest content in vitamin C, vitamin A, and vitamin E. It also contains an enzyme named papain, which is useful in the treatment of many diseases, such as trauma, allergies, and sports injuries, and it is having medicinal properties, such as antifungal, antimalarial, anti-amoebic, anti-helminthic, antimicrobial, male antifertility, diuretics, female antifertility, immunomodulatory, nephroprotective [3].

BOTANICAL DESCRIPTION AND CULTIVATION

Papaya plants are long-stemmed plants that have heights up to 10 meters [4]. The plant grows rapidly and starts fruiting after one year of plantation, and the production life of the plant is about three years from plantation, so their production period is about 2 years. The papaya fruit is green in color when they start to grow; after completion of their growing period, they become yellow or orange in color [5]. Papaya is a fruit with a delicious, sweet taste and a pleasant aroma. It has a soft texture. The leaves of the plant are big and spirally arranged around the stem up to the top. Flowers are pale white in color. They have both male and female flowers, female flowers having no stamens, 3-5 cm long, with an ovary present in it. The male flowers have 2 rows with 10 stamens, 5-carpellete ovary whose presence depend upon the age of plants. The ripening of papaya increases the sweetness, while overripe fruit quickly starts deteriorating (Table 1) [6].

Papaya contains a number of nutrients. All these nutrients of papaya as a whole improve CVS, such as heart disease as well as it also prevents from colon cancer. They also help to prevent strokes along with heart attack problems. They also reduce high cholesterol levels because it is a rich source of fibre [3]. The fruit of the papaya is a climacteric and exhibits an increase in respiration and ethylene production during ripening. A fruit grows rapidly and ripens fast at room temperature. The shelf life of the ripped fruit is short. It may be up to 2 to 3 days [5].

The plant has a weak and unbranched soft stem that yields the latex (white, milky fluid). The papaya plant looks like a tree, because they have a trunk. Papaya is grown from the seed, and the development of this plant is very fast [6].

Table 1. Botanical classification [7].

Domain	**Flowering Plant**
Botanical Name	*Carica Papaya Linn.*
Genus	*Carica*
Family	*Caricaceae*
Order	*Brassicales*
Phylum	*Stetophyta*
Kingdom	*Plantae*
Sub Kingdom	*Tracheobionta*
Class	*Magnoliopsida*
Sub Class	*Dilleniidae*
Super Division	*Spermatophyta*

GENERAL CHARACTERISTICS AND USES OF PAPAYA

Papaya is a great, loving tropical fruit that was sensibly known as “The Fruit of Angels by Christopher Columbus”. Ripped papaya fruit have a rich orange or yellow color. The inner activity of the fruit contains black round-shaped seeds. The other parts of the papaya plants, such as the stem, leaves, and some unripe fruits of the plant, release a white coloured milk like fluid that consists of sugars, oils, tannins, gums, and protein-like substances in their composition, which coagulate when they come in contact with air. The green colored or unripe papaya is rich in the content of papain and chymopapain. The papain enzyme is a proteolytic enzyme that helps in the breakdown of proteins and makes it easy to digest them. Papain is also used to soften the meat because they have the ability to break the tough fibres present in meat. They are also used in wine and beer making and also used in textile industries

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[8]. The ripped papaya fruit is eaten raw without the peel and seeds. The black seeds (round-shaped) are edible and are spicy in taste. The stem and bark of the plant are also used to make ropes by drying the stem and bark. Papaya is used in the production of soft drinks and ice cream and also used as a flavour in various pharmaceutical products to mask the taste of pharmaceutical preparations. It is mostly used in syrup as a flavouring agent in pharmaceutical use [9–12].

The papaya ring pot virus came around in the 1940s and wiped out the papaya crops around the world. A genetically modified variety named Rainbow papaya was developed in the 2000s that is resistant to the virus. They are the first GMO fruit in commercial production [13].

When the fruit starts the ripening, then its color changes, which is due to the breakdown and disappearance of the chlorophyll in the fruit. The chlorophyll present in the fruit is responsible for its green color. The flesh color of papaya defines a quality rate that correlates it with its nutritional values. All the genomic sequences of both yellow coloured and red fleshed papayas have been identical according to the reports [14].

CHEMICAL COMPOSITION OF PAPAYA

Papaya is a valuable medicinal plant with various nutritional values. The medicinal and nutritional values of papaya are closely related to each other. Papaya is a nutrient-rich fruit because it provides many more nutrients as compared to other fruits. The different parts of the papaya plant, such as roots, leaves, latex (white milky-like fluid), bark, fruit, fruit juice, and seeds contain various chemical constituents, which are as follows in Table 2:

Table 2. Chemical composition of various parts of the papaya plant [8, 10, 12].

Part	Constituents
Fruits	Fat, carotene, fibre, carbohydrates, minerals: phosphorous, calcium, iron, vitamin C, thiamine, amino acids, riboflavin, niacin, protein, citric and mallic acids (green fruits), volatile compounds: benzyl isothiocyanate, cis and trans 2,6-dimethyl-3,6 epoxy-7 octen-2-ol, Linalool, aalkaloid, alpha carpaine, benzyl- beta-D glucoside, 2- phenylethyl-beta-D-glucoside, 4-hydroxy-phenyl-2 ethyl-beta-D-glucoside
Latex	Glutamine cyclotransferase, lysozymes and peptidase A and B, proteolytic enzymes, papain, chymopapain
Root	Myrosin (enzyme), carposide
Juice	Stearic, palmitic, N-butyric, N-octanoic acid, oleic acids, myristic, linoleic, N-hexanoic
Leaves	Pseudocarpain, dehydrocarpaine 1 and 2, choline, alkaloids carpain, carposide, vitamin C and E.
Seed	Myrosin (enzyme), glucotropacolin, fatty acids, papaya oil, benzylthiourea, caricin, beta-sistosterol, crude protein, crude fibre
Bark	Fructose, galactose, beta-sitosterol, glucose

NUTRITIONAL VALUE OF PAPAYA

Papaya is a common fruit with high nutritional value available at a very reasonable price in the market. It is rich in vitamins and minerals and low in calorific value. They have a low calorie content, which is 32kcal/100 g of ripe fruit. These are beneficial for those people who want to reduce their body weight. It contains low amounts of carotene, which helps to prevent damage by free radicals compared to other fruits. If the patient cannot digest the wheat protein gliandin, then this disease is called celiac disease and it is treated with the use of papain. Fermented papaya is used as an antioxidant. In the Asian region, the leaves of papaya are eaten like spinach after steaming them [11].

Unripened green papaya is also used as a vegetable. Green papaya does not contain carotene, but it contains all other nutrients. It is also used in pies, sherbets, and salads. The regular consumption of papaya ensures a good supply of vitamins A and C, which are required or essential for the proper working of the body and good for weak eyesight. Regular consumption also helps to prevent blindness in children [10]. The nutritional value of 100gm papaya is described below (Table 3).

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Table 3. Nutritional value for 100 g of *Carica papaya Linn*. fruit [10, 12].

Constituents		Ripe Papaya	Green Papaya
1.	Protein	0.6 g	0.7 g
2.	Minerals	0.5 g	0.5 g
3.	Fiber	0.8 g	0.9 g
4.	Fat	0.1 g	0.2 g
5.	Carbohydrates	7.2 g	5.7 g
6.	Energy	32 kcal	27 kcal
7.	Total	2,740 µm	0
8.	Carotene	888 µm	0

MEDICINAL VALUE OF PAPAYA

According to ancient literature, all parts of the papaya plant have various medicinal uses. In these, especially the Ayurvedic have been summarized in Table 4:

Table 4. The medicinal uses of the *Carica* papaya plant are mentioned in ancient Ayurvedic literature [4, 10, 15].

Part	Medicinal Uses
Ripe fruits	Expectorant, carminative, piles, chronic diarrhoea, diuretic, stomachic, dysentery, sedative, digestive, urinary tract wounds, ringworm, and obesity.
Unripe fruit	Anti-bacterial activity, removes poison after snakebite, and is a diuretic, abortifacient, and laxative.
Seed juice	Carminative, piles, liver treatment, spleen treatment.
Seeds	Vermifuge, Anti-fertility in males, emmenagogue, abortifacient, liver treatment, counter-irritant, ringworm, carminative.
Latex	Whooping cough, anthelmintic, diarrhoea, haemorrhage, carminative, stomachic, relieves dyspepsia.
Leaves	Beriberi, dressing wounds, young leaves, gonorrhea, asthma, fever, jaundice, abortion, urinary disease.
Flowers	Pectoral properties, jaundice, febrifuge.
Root	Diuretic, piles, anti-fungal, stop bleeding from uterus, abortifacient.
Stem bark	Antifungal, jaundice, anti-haemolytic, STD, sore teeth.

The papaya plant has various medicinal activities like anti-hypertensive, antioxidant, wound healing, hepatoprotective, anti-fungal, histaminergic, anti-fertility, diuretic, anti-amoebic, anthelmintic, anti-tumour, effect on smooth muscles, antimalarial, immunomodulatory activity, anti-sickling activity, and anti-ulcer activity. All these activities of the papaya are described below.

Anti-Hypertensive Activity

The ripe fruit of papaya is used for the anti-hypertensive activity. The ethanolic extract from the ripped papaya is used to reduce blood pressure. The hydralazine and also the ethanolic extract from unripe fruit of papaya produce depression of mean arterial blood pressure (MAP) in normotensive, hypertensive animals' groups as compared to control. The extract produced about 28% more depression of mean arterial blood pressure than hydralazine in the hypertensive group. This report clears that the unripe fruit of *Carica* papaya had a potent anti-hypertensive activity [16].

Antioxidant Activity

The unripe fruit of the papaya contains a methanolic compound. The methanolic extract was evaluated in vivo for its effect on the activity of some antioxidant enzymes that include glutathione peroxidase, glutathione transferase, and glucose-6-phosphate in mice treated with an oral dose of 100 mg/Kg. There is an increase in activity due to the ethyl acetate fraction. It is suggested that quercetin is responsible for antioxidant potential [17].

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Wound Healing Activity

The aqueous extract of the papaya fruit has wound healing properties because it promotes healing by enhancing the collagen turnover and wound contraction in streptozotocin-induced diabetic rats by using wound models as well as excision (surgical removal). They give about 77% reduction in the area of wound. The papaya extract was applied on the wound topically to promote healing. So, the extract of the papaya had a good wound healing property [18].

Hepatoprotective Activity

Both the ethanol and aqueous extract of the papaya fruit have remarkable hepatoprotective activity against the induced hepatotoxicity [19]. They lower the biochemical parameters, such as SGPT, SGOT, and alkaline phosphates [20].

Anti-Microbial Activity

The papaya contains the aqueous extract that shows anti-microbial activity. The aqueous extract is mostly extracted from leaves and roots at different concentrations (25, 50, 100, 200 mg/ml) for anti-microbial activity [21]. The seed of papaya is also used for antimicrobial activity. The seeds of papaya show activity against the Trichomonas vaginalis trophozoites. The use of papaya is also suggested for disorders like trichomoniasis to avoid toxicity [22]. The pulp and seed of papaya also show bacteriostatic activity against various enteropathogens, such as *Pseudomonas aeruginosa, Enterobacter, and Bacillus subtilis* by the agar cup plate method [23]. Various herbal formulations contain papaya leaves, roots, or only one part of the papaya plant as one of the constituents that show antibacterial activity against various types of bacteria, while the other extract of the papaya plant, such as acetone, water, and ethanol, does not show microbicidal activity [24].

Anti-Inflammatory Activity

Papaya contains some natural pain-relieving abilities that reduce inflammation. The enzymes present in papaya, such as papain and chymopapain, which are the digestive enzymes, help in lowering inflammation and also help in the healing of burns. They can also lower the inflammation in the body, pain and oedema caused by sport injuries. The antioxidant present in papaya also shows anti-inflammatory activity. Due to the anti-inflammatory activity of papaya, they also help in rheumatoid arthritis, polyarthritis, and osteoarthritis [25].

Anti-Fungal Activity

The latex of the papaya plant and fluconazole show synergistic activity on the inhibition of *Candida albicans* growth. This activity results in cell wall degradation. The fungistatic effect is because of cell wall degradation that occurs due to lack of polysaccharides content in the outermost layer of the fungal cell wall [26]. The latex of the papaya plant is responsible for the antifungal action, and the minimum concentration required for the inhibition was reported as 138 mg/ml [27].

Histaminergic Activity

The crude extract of the papaya plant caused concentration-dependent contraction of ideal strips suspended in the Yrode solution, which is mediated via H1 receptor and is dependent on extracellular calcium influx. The flower of the papaya plant has pollen. The pollen is able to induce IgE-mediated allergy [28].

Anti-Fertility Activity

The extract from the bark of the papaya plant shows anti-fertility activity. The extract from the bark shows activity on the seminiferous tubules of rats and causes complete loss of fertility. They show a decline in sperm motility and also an alteration in the morphology. So, the extract from the bark of the papaya plant serves as a good contraceptive in animals [29].

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Diuretic Activity

The aqueous extract obtained from the root of the papaya shows diuretic activity. When the aqueous extract is given orally to the rats at the dose of 10 mg/kg, then they produce a significant increase in the urination. They show a similar effect to the drug hydrochlorothiazide [30].

Anti-Amoebic Activity

The extract of the matured papaya seeds shows anti-amoebic activity. The cold macerated aqueous extract shows anti-amoebic activity against Entamoeba histolytica [31].

Anthelmintic Activity

The latex of the papaya has anthelmintic activity against the *Heligmosomoides polygyrus*. It also has anthelmintic activity against the infection of Ascaris suum in pigs, and it is found effective when the dose of 8 g/kg body weight is given. The dried seeds of the papaya are issued for anthelmintic activity. The dried seeds of the *Carica* papaya are given with honey to show the activity against the human intestinal parasites. They paralyze and kill the worms present in the intestine. They show better anthelmintic activity than standard drugs [32].

Anti-Tumour Activity

The aqueous extract from the leaves of the papaya plant shows anti-tumor activity. The extract inhibits the proliferative response from the solid tumor cell [33].

Effect on Smooth Muscles

The extract of the papaya seed shows an effect on the muscles. The ethanol extract of the papaya seed at 0.1–6.4 mg/ml shows concentration-dependent inhibition of the jejunum contraction. They are capable of reducing the contractile ability of the rabbit jejunum [34].

Anti-Malarial Activity

The extract from the epicarp of the raw papaya shows anti-malarial activity. The petroleum ether extract of the epicarp of the raw papaya fruit shows significant anti-malarial activity. The dose of the extract ranging from 0.05-1.000 µg/ml shows that the anti-malarial activity depends on the concentration [35].

Immunomodulatory Activity

The extract of the papaya seed containing chemical constituents and its bioactive fraction were examined in vitro using lymphocyte proliferation assay and complement-mediated hemolytic assay. The extract of the papaya seed is currently marketed as a nutritional supplement that gives energy to the body. This product claims to increase immunity against common infections [36].

Hypoglycaemic Activity

The extract of the papaya leaves shows hypoglycaemic activity. The ethanolic leaf extract of papaya significantly reduces the sugar level in the blood. They reduce the sugar level significantly at the dose of 5.0 mg/kg with no significant effects at the higher dose of 10mg/kg. The fruit of papaya contains flavonoids that are natural antioxidants and may help to regulate blood sugar level. They also improve the lipid profile in the diabetic patient. The aqueous extract of papaya leaves also positively affects the integrity and all the functions of both the liver and pancreas. They delay the hypoglycemic activity of glimepiride and increase the effect of metformin. They have variable interacting effects for each drug extract combination [37].

Anti-sickling Activity

The extract of the papaya also shows anti-sickling activity. The methanolic extract of papaya at a dose of 10mg/ml in vitro reduces haemolysis and protects erythrocyte membrane integrity under osmotic stress conditions [38].

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Anti-Ulcer Activity

The extract of the seed of the papaya shows anti-ulcer activity. The aqueous extract of papaya shows activity against alcohol induced acute gastric damage. They show activity at the doses of 50 mg/kg and 100 mg/kg. The gastric acidity in rats was reduced when they were given 100 mg/kg of the extract [39].

Additional Benefits of Papaya

Papaya is a fruit that is a rich source of nutrients, such as pro vitamin, vitamin C, B, dietary fibers, and minerals. The benefits of papaya also include an increase in appetite, acting as an acne medicine, lowering fever, easing menstrual pain, and fighting dandruff. They are also used as cosmetics to treat pimples and wrinkles by rubbing the pulp. They are also a good bleaching agent and are used as an important ingredient in bath soap. They help in removing dead, worn-out skin cells and lightening the colour of the skin [4].

Papaya in Case of Pregnancy

The papaya contains various enzymes, such as papain and chymopapain. They are both present in the latex obtained from the papaya plant. These enzymes can cause an increase in the uterine contractions because the papain enzyme acts, like the prostaglandin and oxytocin hormone, which both are known to put a mother's body into labour, and hence, they can cause adverse effects on the offspring and the mother's health. The latex also causes oedema and haemorrhage in the placenta that result in severe complications in pregnancy [4].

CONCLUSIONS

Papaya is generally known as a phytoconstituent, a nutritional as well as medicinal fruit that is a unique source of various types of protein, minerals, vitamins, etc. They also contain various types of enzymes that make them a nutraceutical plant. They also have pharmacological and medicinal value. Because of this, it is traditionally claimed to be a powerful medicine. The review is all about the nutritional and medicinal value of the papaya plant and its parts.

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