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Review Paper

Carica Papaya: A Multifunctional Tropical Plant with Nutritional, Medicinal, And Therapeutic Importance

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ABSTRACT

Carica papaya Linn., commonly known as papaya, is an important medicinal plant belonging to the family Caricaceae and is widely valued for its nutritional, medicinal, and pharmacological properties. It is widely cultivated in tropical and subtropical regions due to its adaptability and economic importance. Almost all parts of the plant, including fruits, leaves, seeds, roots, bark, and latex, are utilized in traditional and modern medicine. Papaya is rich in vitamins, minerals, antioxidants, and bioactive enzymes such as papain and chymopapain, which contribute to biological activity. The plant shows promising pharmacological activities, including antimalarial, anticancer, antidiabetic, anthelmintic, antifertility, anticoagulant, digestive, anti-inflammatory, antimicrobial, immunomodulatory and dengue-supportive effects. This review highlights the botanical description, chemical constituents, therapeutic benefits, and pharmacological activities of Carica papaya, emphasizing its potential as a valuable nutraceutical and medicinal plant.

INTRODUCTION

Carica papaya Linn is a member of the family Caricaceae and it is called as “papaya” in English, “papita” in Hindi, and “erandakarkati” in Sanskrit. In sixteenth century, papaya plant was brought from its originated place America. It is rich in antioxidants such as vitamin C, A, and E as well as minerals including magnesium and potassium. Vitamin B, pantothenic acid, folate, and fiber are

also present in carica papaya and it is used as nutraceutical.

It contains enzyme “papain” which helps in digestion and also cures allergies, injuries, and trauma. When it is taken as a food it strengthens the circulatory system and guard against heart disease, heart attacks, strokes and protect from colon cancer. [1,2].

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Fig 1: Carica papaya plant

Papaya Plants has special cells called lactifers, and it is dispersed in all parts of plant. Due to its active component plants showed wide pharmacological importance. Present review revealed plants description, phytoconstituents and biological activity of Papaya plant.

Local names [2]and varieties [3]:

Different countries know Carica in their local names such as Papita(India),Tree-melon(Holland),Papaya(France),PawPaw(Austral

ia),Mamao(Brazil) and Papaya/ Paw Paw (UK). Papaya mainly comes in two varieties, Solo and Mexican. The Solo variety is the mostly consumed in the United States. These papayas are pear-shaped and usually around six inches in length. In contrast, Mexican papayas are much larger in size, sometimes weight more than ten pounds and reaching nearly two feet in length. Compared to Solo papayas, Mexican varieties generally have a greener outer skin and tend to be less sweet in taste. Examples of Solo varieties include Kamiya, Solo, Sunrise (Sunrise Solo), Sunset (Sunset Solo), Vista Solo, and Waimanalo (Carvalho, Renner et al., 2013).

Botanical Classification [4]:

Papaya plant is dicot angiosperm characterized by hollow, unbranched stem, palmately leaves and a botanical structure that is often dioecious. Botanical classification is hierarchical structure, it means drugs are arranged in this manner as Kingdom, Division, Class, Order, Family, Genus and Species. Taxonomical classification of Papaya is given below in table 1.

Table 1. Botanical classification of Papaya

Taxonomic rank	Botanical group
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	<i>Carica papaya</i> Linn

Origin and Geographical distribution:

It is believed that papaya arise from natural hybridization involving carica peltata Hook, as the genus carica L. It is indigenous to the tropical regions of America. During the Spanish expeditions in the sixteenth century, papaya was

brought from America to the Caribbean and Southeast Asia. From there, it spreads quickly to Africa, Oceania and India. Nowadays papaya is cultivated throughout the tropical and warmer subtropical regions of the world [5].

Cultivation and collection [6]:

Papaya is a fast-growing tropical fruit crop that performs best in warm climates with plenty of sunlight requires well-drained fertile soil. It grows ideally in soil with a pH range of 6.0 to 7.5, which supports good nutrient availability, and requires a temperature between 22°C and 30°C for optimum growth, as very low temperatures or frost can damage the plant while excessive heat can reduce fruit quality. Cultivation begins with proper land preparation, including ploughing and removal of weeds, followed by digging pits that are filled with organic manure before planting. Adequate spacing between plants about 1.5 to 2 meters is maintained to ensure proper air circulation and healthy development. Papaya plants need a balanced supply of nutrients, so organic manure along with fertilizers such as nitrogen, phosphorus, and potassium are applied at different stages of growth. Regular irrigation is essential, particularly during early growth and summer months, but care must be taken to avoid water logging, as it can harm the roots. Intercultural operations like weeding, earthing up, staking to support the plant, and thinning of excess fruits are important for better growth and fruit quality. Proper pest and disease management is also necessary to control insects like aphids and whiteflies and diseases such as damping-off and powdery mildew.

Papaya plants start bearing fruits within 6 to 7 months after planting, and the fruits become ready for harvesting in about 10 to 11 months. The maturity of the fruit is identified when its color changes from dark green to light green or slightly yellow, and the latex becomes watery instead of thick. Harvesting is done carefully by hand or with a knife to prevent damage to the fruits. A healthy and well-managed plant can produce around 30 to 50 kilograms of fruits. In addition to fruit harvesting, papain, a valuable enzyme, can be collected from immature fruits by making small cuts on their surface to extract latex, which is then

dried and processed for various industrial uses. Thus, proper cultivation practices, suitable pH and temperature conditions, and timely harvesting play a crucial role in obtaining high yield and good quality papaya fruits.

Morphological Description [5]:

Carica papaya is fast growing dioecious tree like herb which has height of 2-10 m. It is usually unbranched (branches form only after injury) and contains white latex in all parts. Its stem is hollow, cylindrical, 10-30 cm thick, with leaf scars and spongy fibers. Papaya leaves have spiral arrangement and clustered at the top. Petiole is up to 1 m, hollow, green to purplish green. Leaf blade is round, 25-75 cm wide and have smooth, clear veined, deeply 7-11 lobed, with broad teeth. Flowers are polygamous such as male, female, and hermaphrodite flowers on different trees. Male flowers occur in pendant panicles which is 25-100 cm long, sessile is small 5-toothed calyx. Corolla is pale yellow, trumpet shaped and is 2.5 in cm and 10 stamens are arranged in two whorls. Female flowers are solitary or in small clusters which has size upto 3.5-5 cm. Its calyx is in cup shaped with 5 narrow teeth and corolla is fleshy, twisted and almost free of petals. Flower ovary is ovoid oblong in 2-3 cm and have many ovules. In these 5 fan shaped stigmata are deeply divided. Hermaphrodite flowers are two forms 1. Elongata type: In this type short stalked clusters which are partially fused petals and have 10 stamens, elongated ovary. 2. Pentandria type: It is similar to female flowers, having 5 stamens. Its intermediate forms may produce irregular fruit due to carpelloid stamens. Flower types can change with age and environment. Its fruit is large fleshy berry type which has variable shapes like oval, round, pear shaped, cylindrical or grooved. Papaya is 7-30 cm in size and up to 10 kg in weight. Its ripe skin is thin, smooth and yellow orange in color, its flesh is yellow to red orange and have sweet, mild

flavor. The papaya fruit central cavity is in 5 angled. Seeds are round, which has black or grayish color. They are numerous and arranged in five rows inside the fruit. It is surrounded by a gelatinous coating.

Microscopy of leaf [7]:

The transverse section of the *Carica papaya* leaf shows a dorsiventral structure consisting of the midrib, lamina, and petiole.

- **Midrib:**

The midrib is almost spherical in outline and more developed on the lower surface. The upper epidermis is composed of barrel-shaped cells, beneath which lie layers of chlorenchymatous hypodermis and thick-walled sclerenchyma. The vascular bundles are collateral and closed, arranged in a circular manner, and consist of xylem with tracheid and vessels, along with phloem appearing as radially elongated groups separated by parenchymatous tissue. A wide zone of collenchyma is present just above the lower epidermis.

- **Lamina:**

The lamina is differentiated into an upper epidermis, mesophyll, and lower epidermis, all covered by a cuticular layer. The mesophyll includes a single layer of closely packed palisade cells rich in chloroplasts, followed by four to five layers of loosely arranged spongy parenchyma with prominent intercellular spaces. Stomata are predominantly located on the lower epidermis.

- **Petiole:**

The petiole closely resembles the midrib in its anatomical structure and is characterized by the presence of oval to circular lactiferous ducts with thin walls and large cavities.

Microscopy of seed [7]:

A transverse section of *Carica papaya* seed reveals distinct layers including the testa, tegmen, endosperm, and cotyledon. The testa is differentiated into mesotesta and endotesta, as the exotesta is absent. The mesotesta is composed of square to polygonal cells with strongly lignified walls, showing a characteristic zigzag or puzzle-like arrangement and a central lacuna. The endotesta comprises small, irregular shaped, tightly packed cells with thin and wavy walls. Beneath the testa, the tegmen contains thick-walled stone cells, followed by a few poorly defined cell layers. The endosperm consists of densely packed, thick-walled polygonal storage cells containing oil and mucilage. The cotyledon is made up of large, transparent, thin-walled polygonal cells that enclose the embryo.

Nutritional values [8,9]:

Papaya is one of the most widely consumed fruits worldwide and is valued for its strong nutritional profile at a relatively low cost. It is low in calories yet rich in essential vitamins and minerals. In addition to its basic nutrients, papaya contains important bioactive compounds such as tocopherols, phytosterols, flavonoids, carotenoids, and alkaloids. These phytochemicals have significant nutraceutical potential and contribute to the management and improvement of various health conditions, including inflammation, high blood sugar levels, fertility issues, hypertension, and even certain types of cancer. Nutritional value of ripe and unripe pawpaw fruit is given below in table 2.

Table 2: Nutritional value of pawpaw fruits.

Chemical composition	Ripe pawpaw fruit	Unripe pawpaw fruit
Protein	0.6 g	0.7 g
Fat	0.1 g	0.2 g
Crude fibre	0.8 g	0.9 g
Carbohydrate	7.2 g	5.7 g
Energy	32 kcal	27 kcal
Total carotene	2,740 µm	0
Beta carotene	888µm	0
Minerals	0.5 g	0.5 g

Different parts of the papaya plant such as the fruit, seeds, peel, and leaves offer nutritional and therapeutic benefits, making them valuable components of the human diet. These parts contain both macro- and micronutrients in varying amounts. Notably, the seeds and leaves contain approximately 16–32% protein across different cultivars. The seeds are also rich in lipids (about 21–30%) and contain carbohydrates ranging from 8–58%, which makes both seeds and leaves potential alternative energy sources, particularly beneficial for undernourished populations. Fatty acids present in the seeds include oleic, palmitic, arachidic, linolenic, and stearic acids. Due to their high lipid content, papaya seeds hold strong economic potential for industrial oil production compared to many conventional oilseeds. Additionally, both the seeds and peels are good sources of dietary fiber, which supports digestive health, aids in toxin removal, and helps reduce cholesterol levels.

Chemical constituents [10, 11,12,13]:

Papaya plants are particularly rich in bioactive compounds. They contain important phytochemicals, including phenolic compounds, tocopherols, phytosterols, and carotenoids. These naturally occurring substances provide numerous health benefits, ranging from inhibiting the growth of cancer cells to protecting cells from oxidative damage. They also contribute to lowering the risk of various non-communicable diseases.

Compounds such as phenolics, isothiocyanates, terpenes, phytosterols, flavonoids, and anthraquinones help neutralize reactive molecules. By doing so, they safeguard cells from the harmful effects of oxidative stress and inflammation caused by carcinogenic agents, thereby supporting overall cellular health. Bioactive compounds are found in papaya are shown below in table 3.

Table 3: Chemical constituents of Papaya plant.

Plant part	Chemical constituents
Fruit	Protein, fat, fiber, carbohydrates, minerals: calcium, iron, vitamin C, thiamine, riboflavin, niacin, and carotene, amino acid, citric acid and malic acids (green fruits), volatile compounds: benzyl isothiocyanate, cis and trans 2, 6-dimethyl-3,6 epoxy-7 octen-2-ol, alkaloids, carpaine
Juice	N-butyric, n-hexanoic and n-octanoic acids, myristic acid, palmitic acid, stearic acid, linolenic acid, linoleic acid, oleic acid
Leaves	Alkaloids carpaine, pseudocarpain, dehydrocarpaine I and II, choline, vitamin C and E, carposide
Root	Carposides and an enzyme myrosin
Seed	Fatty acids, crude protein, crude fiber, papaya oil, phenolic compounds, tocopherols, phytosterols, carotenoids, carpaine, caricin, glucotropacolin, and an enzyme myrosin

Bark	Glucose, fructose, sucrose, xylitol, β -sitosterol
Latex	Papain, chymopapain, peptidase A and B, lysozymes
Papaya peels	68-87% moisture, 7-20% protein, 0.20 -2% fat, and 3-12% ash.

Benefits of Papaya [14]:

Papaya is a plant of great medicinal importance, as its leaves, fruits, and seeds all provide health benefits. Papaya is very good for human organ like stomach, liver and heart. It is rich in antioxidants such as vitamin A, C, E and protects the heart,

reduces fatty liver and aid detoxification. Regular consumption of Papaya plant parts promotes healthy human health. It promotes better digestion, boosts immunity, enhances skin health, and support liver and heart health. Benefits of Papaya plant parts to human health is given below in table 4.

Table 4: Benefits of Papaya plant parts

Plant part	Benefits
Leaves	Helpful in treating skin conditions such as acne, easing nausea and menstrual discomfort, and stimulating appetite.
Fruits	It has essential vitamins and minerals, promotes digestion, improves bowel movement.
Seeds	It possesses powerful therapeutic properties, including protecting the kidneys, combating harmful bacteria, eliminating intestinal parasites, detoxifying the liver, soothing skin irritation and help reduce fever and typhoid.
Peel	It is use for cosmetic and medicinal purposes, including skin care, dandruff treatment, muscle relaxation and pain relief.
Roots	Its extract helps in relieving urinary issues and digestive problems.

Papain proteolytic enzyme extracted from papaya [15,16,17]:

Papain is an endolytic plant cysteine protease enzyme extracted from the latex of *Carica papaya* (Papaya). It is obtained by making cuts on the skin of unripe papaya fruits, allowing the latex to flow out, which is then collected and dried. The greener and more immature the fruit, the higher collection of papain. Papain belongs to proteolytic enzymes and plays an important role in many biological processes in living organisms. Papain functions as a catalytic enzyme that hydrolyzes proteins with broad specificity toward peptide bonds in esters and amines. It has strong proteolytic activity and can break down proteins, short-chain peptides, amino acid esters, and amide bonds such as arginine and lysine, and also those occurring after phenylalanine residues. Because of these

properties, papain is widely used in food processing and medical applications. In papain, interactions between hydrophobic and hydrophilic amino acids in the side chains are important thermodynamic factors that influence protein folding. Investigation studies explored intermediate states of papain using different concentrations of n-alkyl sulfates, such as sodium octyl sulfate (SOS), sodium decyl sulfate (SDeS), and sodium dodecyl sulfate (SDS), have shown that hydrophobic interactions significantly contribute to the formation of two distinct intermediate states through different thermodynamic pathways. Papain exhibits a preference for an amino acid bearing a large hydrophobic side chain at the P2 position. It does not accept Valine at the P1 position. The hydrophobicity of papain was analyzed using the

carbon distribution profile along its amino acid sequence. The analysis was revealed that the carbon content remains approximately 31.45% throughout the sequence. Certain regions display carbon values higher than 31.45%, which are considered more hydrophobic areas based on carbon distribution profiling methods. Maintaining an overall carbon content of about 31.45% across the sequence is associated with the structural stability of the papain enzyme. Previous studies have suggested that stable and well-ordered proteins typically maintain this level of carbon distribution throughout their sequences, which contributes to proper protein folding and stability [18,19,20,21,22,23].

Mechanism of action of Papain [15,17,24,25,26]

The functional mechanism of papain is mainly associated with the cysteine-25 residue located in the active site of the enzyme. This residue attacks the carbonyl carbon of the peptide bond in the protein backbone, which leads to the release of the amino-terminal portion of the peptide. As this reaction continues along the peptide chain, the protein gradually breaks down into smaller fragments. The cleavage of peptide bonds occurs when cysteine-25 is activated through deprotonation by histidine-159. Asparagine-175 assists by positioning the imidazole ring of histidine-159 in the proper orientation, allowing the deprotonation process to occur effectively. Although these amino acids are distant in the primary sequence, the folding of the protein structure brings them close together in the active site. The cooperative action of these three residues forms the catalytic triad responsible for the enzymatic activity of papain.

During catalysis, cysteine-25 performs a nucleophilic attack on the carbonyl carbon of the peptide backbone. In the active site, cysteine-25 and histidine-159 function together as a thiolate–imidazolium ion pair, which plays a key role in the

catalytic process. Papain activity can also be inhibited by certain compounds such as peptidyl or non-peptidyl N-nitroso anilines. This inhibition occurs through the formation of a stable S–NO bond at the active site cysteine residue, resulting in enzyme inactivation.

Medical Applications of Papain enzyme [27,28,29,30,31,32,33]

Papain functions as a debris-removing agent and does not damage healthy tissues because of its enzymatic specificity. Mainly it acts on tissues that lack the protective plasma antiprotease α 1-antitrypsin, which normally prevents protein breakdown in healthy tissue. In dental treatments, papain helps remove carious tissue through biochemical processes that break polypeptide chains and hydrolyze collagen cross-links. These cross-links normally provide strength and stability to collagen fibrils; when they are broken, the collagen structure becomes weaker and can be more easily removed using papain-based gels. Because of this property, papain gels are considered useful for biochemical excavation procedures in dentin and for the chemo mechanical removal of dental caries. Another advantage is that papain does not interfere with the bonding strength between restorative materials and dentin.

Papain has also been widely used in medical treatments for sports injuries, traumatic conditions, and allergic reactions. The enzyme has shown beneficial effects in promoting faster healing of minor injuries. Studies have reported that individuals using papain protease supplements experienced significantly shorter recovery times compared with those who did not use them. In addition, papain has been used to help manage digestive and allergic conditions such as leaky gut syndrome, low stomach acid production (hypochlorhydria), and intestinal imbalance including gluten intolerance. It has also demonstrated analgesic and anti-inflammatory

properties, reduce symptoms of acute allergic sinusitis, including headaches and toothache pain, without causing side effects.

Pharmacological activity: Carica papaya is a tropical plant with a profile of biological activities. Some notable biological activities of Carica papaya are given below in the figure 2:

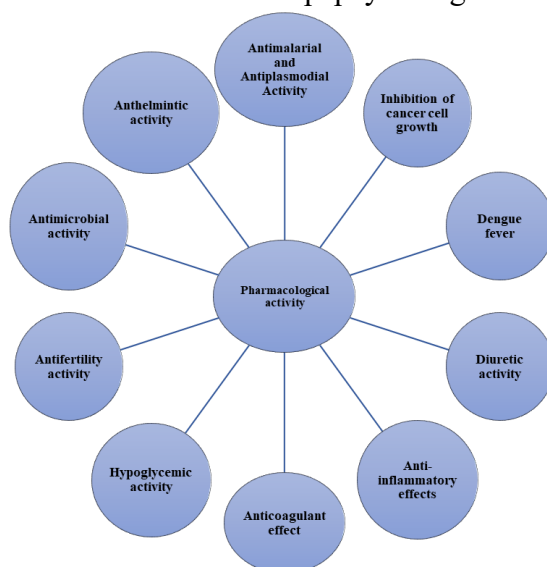


Fig 2: Pharmacological activity of Carica papaya

Antimalarial and Antiplasmodial Activity[2]

Papaya leaves are traditionally prepared as a tea and used in the treatment of malaria. Research revealed that Some extracts of the plant parts have shown ant malarial and anti plasmodial effects; however, the exact mechanism of action is still unclear and has not yet been scientifically established.

Inhibition Of Cancer Cell Growth[2]

Recent studies on papaya leaf tea extract were indicated their potential to inhibit the growth of cancer cells. This effect is believed to be associated with an increase in Th1-type cytokines, which play an important role in regulating immune system responses.

Dengue Fever management[2,41]

Based on studies conducted by Dr. Sanath Hettige involving 70 dengue patients, papaya leaf juice was reported to increase white blood cell and platelet counts. It also helps restore normal blood clotting functions and supports liver repair.

Diuretic Activity[3]

Oral administration of aqueous extract of papaya roots at a dose of 10mg/kg in rats was resulted in a significant rise in urine output. The pattern of electrolyte excretion observed was comparable to that produced by hydrochlorothiazide.

Anti-inflammatory Effects[34]

Papaya contains proteolytic enzymes such as papain and chymopapain, along with antioxidant nutrients including vitamin C, vitamin E, and beta-carotene. These components help reduce the severity of inflammatory conditions like asthma, osteoarthritis, and rheumatoid arthritis.

Anticoagulant Effect[35]

Administration of papain extract by injection in dogs has been shown to increase prothrombin levels and blood coagulation activity. Papain also reported to aid in the removal of necrotic tissue in chronic wounds, burns, and ulcers. In addition, this enzyme has significant commercial application in the brewery, food, and textile industries.

Hypoglycemic Activity[36]

An ethanolic extract of *Carica papaya* leaves administered at a dose of 5mg/kg resulted in a significant reduction in blood glucose levels, whereas a higher dose of 10mg/kg showed no marked effect. The extract delayed the onset of hypoglycemic action of glimepiride and enhanced the glucose lowering effect of metformin, with different interaction patterns observed for each drug extract combination.

Antifertility Activity[37]

Oral administration of crude bark extract of *C. papaya* at dose of 5-10 ml/kg/day for four weeks in rats led to complete loss of fertility. This effect was attributed to reduced sperm motility and alteration in sperm morphology, suggesting that the bark extract may serve as a safe and effective male contraceptive in animal studies.

Antimicrobial Activity[38,39]

Evaluation of antimicrobial potential of various carica papaya leaf extracts was studied by Baskaran et al. (2012) using solvents such as ethanol, ethyl acetate, acetone, chloroform, petroleum ether, hexane, and distal water. The results showed that all extracts exhibited activity against bacterial and fungal organisms. Among them, the chloroform extract demonstrated the highest effectiveness against *Micrococcus luteus*, while the acetone extract showed greater activity against the fungal strain *Candida albicans*.

Anthelmintic Activity[40]

Papaya has traditionally been used to treat helminthic infections. The plant contains proteolytic enzymes with low toxicity, which were historically employed for managing gastrointestinal nematode infestations. During the mid nineteenth century, papain extracted from papaya latex was found to be effective in worm digestion by rapidly breaking down the cuticle of *Ascaris* species.

CONCLUSION

Carica papaya Linn. is a highly valuable tropical plant recognized for its remarkable nutritional, medicinal, and pharmacological properties. Almost every part of the plant, including the fruit, leaves, seeds, roots, bark, and latex, possesses beneficial bioactive compounds that contribute to its therapeutic potential. Papaya is rich in essential nutrients such as vitamins, minerals, dietary fiber, and important enzymes like papain and chymopapain, which play a significant role in digestion and overall health. In addition, the plant contains several phytochemicals including flavonoids, phenolic compounds, carotenoids, phytosterols, and alkaloids that exhibit antioxidant, anti-inflammatory, antimicrobial, and anticancer activities.

Scientific studies have demonstrated that papaya shows a wide range of pharmacological effects such as antimalarial, antidiabetic, antimicrobial, antifertility, anticoagulant, and anti-inflammatory activities. The papain enzyme derived from papaya latex has important medical and industrial applications due to its strong proteolytic activity and ability to promote wound healing and tissue repair. Moreover, papaya leaves have gained attention for their role in dengue fever management by helping increase platelet and white blood cell counts.

Due to its high nutritional value, wide therapeutic applications, and ease of cultivation, *Carica papaya* has significant potential in the fields of medicine, nutraceuticals, and food industries. However, further clinical studies and scientific investigations are required to better understand its mechanisms of action and to develop safe, effective plant-based formulations. Overall, *Carica papaya* stands as a promising natural resource with considerable healthcare, economic, and pharmaceutical importance.



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REFERENCES

1. Sindhu G, Ragini G, Sreehari L, Gayathri G, Thejaswee A, Inthiyaz SK, Usha Kiran Reddy T, Thyagaraju K. Pharmacognostical and pharmacological profile of *Carica papaya* – A review. *World Journal of Pharmacy and Pharmaceutical Sciences*. 2023;8(4):675–694.
2. Aravind G, Debjit B, Duraivel S, Harish G. Traditional and medicinal uses of *Carica papaya*. *Journal of Medicinal Plants Studies*. 2013;1(1):7–15.
3. Begum M. Phytochemical and pharmacological investigation of *Carica papaya* leaf. 2014.
4. Parle, Milind & Bhardwaj, Gurditta. (2011). Basketful benefits of papaya. *International Research Journal of Pharmacy*. 2. 6-12.
5. Villegas VN. *Carica papaya* L. In: Verheij EWM, Coronel RE, editors. *Edible fruits and nuts. Plant Resources of South-East Asia No. 2. Bogor (Indonesia): Prosea Foundation; 2020.*
6. BigHaat. Papaya cultivation practices for a bountiful harvest. Available from: <https://www.bighaat.com/hi/kisan-vedika/blogs/papaya-cultivation-practices-for-a-bountiful-harvest> [Accessed 2025 Nov 02].
7. Dutta S, Das M, Mitra A. Macro-microscopic and phytochemical studies of papaya (*Carica papaya* L.) with special reference to quality assurance profiles. *Journal of Drug Research in Ayurvedic Sciences*. 2024;9(2):99–110.
8. Krishna K, Paridhavi M. Review on nutritional, medicinal and pharmacological properties of papaya (*Carica papaya* Linn.). *Natural Product Radiance*. 2008; 7:364–373.
9. Kadiri O, Olawoye B, Fawale OS, Adalumo OA. Nutraceutical and antioxidant properties of the seeds, leaves and fruits of *Carica papaya*: A review. *Turkish Journal of Agriculture - Food Science and Technology*. 2016;4(12):1039–1052.
10. Kesavan D, Soumya M, Praveena V, Hitha V, Thoyiba VM. Nutraceuticals and bioactive potentials of *Carica papaya* Linn. In: Madhiyazhagan P, Cheruparambath P, Deepa K, editors. *Exploring boundless frontiers: Interdisciplinary perspective in research*. India: Thanuj International Publishers; 2024. p.81–82.
11. Vij T, Prashar Y. A review on medicinal properties of *Carica papaya* Linn. *Asian Pacific Journal of Tropical Disease*. 2015; 5:1–6.
12. Jean B. *Carica papaya*. In: *Pharmacognosy, phytochemistry of medicinal plants*. 2nd ed. France: Lavoisier; 1999. p.221–223.
13. Nadkarni AK. *Indian Materia Medica*. India: Bombay Popular Prakashan; 1998.
14. Urooj F, Sammia S. Pharmacological activities of *Carica papaya* Linn. *Journal of Basic & Applied Sciences*. 2018; 14:210–216.
15. Tsuge H, Nishimura T, Tada Y, Asao T, Turk D, et al. Inhibition mechanism of cathepsin L-specific inhibitors based on the crystal structure of papain-CLIK148 complex. *Biochemical and Biophysical Research Communications*. 1999; 266:411–416.
16. Uhlig H. *Industrial enzymes and their applications*. 1st ed. New York: John Wiley and Sons; 1998. p.454.
17. Menard R, Khouri HE, Plouffe C, Dupras R, Ripoll D, et al. Role of aspartate 158 in the catalytic mechanism of papain. *Biochemistry*. 1990; 29:6706–6713.



18. Chamani J, Heshmati M, Rajabi O, Parivar K. Thermodynamic study of papain intermediate state. *Open Surface Science Journal*. 2009; 1:20–29.
19. Kamphuis IG, Drenth J, Baker EN. Thiol proteases comparative studies. *Journal of Molecular Biology*. 1985; 182:317–329.
20. Stevenson ED, Storer CA. Papain in organic solvents. *Biotechnology and Bioengineering*. 1991; 37:519–527.
21. Wang LJ, Sun N, Terzyan S, Zhang XJ, Benson DR. Histidine/tryptophan interaction stabilizes protein folding. *Biochemistry*. 2006; 45:13750–13759.
22. Rajasekaran E, Vijayasathy M. CARBANA: Carbon analysis program. *Bioinformation*. 2011; 5:455–457.
23. Jayaraj V, Suhanya R, Vijayasathy M, Anandagopu M. Role of hydrophobic residues in proteins. *Bioinformation*. 2009; 3:409–412.
24. Guo Z, McGill A, Yu L, Li J, Ramirez J, et al. S-nitrosation of proteins. *ChemInform*. 1996.
25. Guo Z, Ramirez J, Li J, Wang PG. Peptidyl N-nitrosoanilines as cysteine protease inhibitors. *Journal of the American Chemical Society*. 1998; 120:3726–3734.
26. Xian M, Chen X, Liu Z, Wang K, Wang PG. Inhibition of papain by S-nitrosothiols. *Journal of Biological Chemistry*. 2000; 275:20467–20473.
27. Flindt ML. Allergy to alpha-amylase and papain. *Lancet*. 1979; 1:1407–1408.
28. Beeley JA, Yip HK, Stevenson AG. Chemomechanical caries removal. *British Dental Journal*. 2000; 188:427–430.
29. Piva E, Ogliari FA, Moraes RR, Cora F, Henn S, et al. Papain-based gel for caries removal. *Brazilian Oral Research*. 2008; 22:364–370.
30. Lopes MC, Mascarini RC, Silva BM, Florio FM, Basting RT. Papain-based gel effect on dentin strength. *Journal of Dentistry for Children*. 2007; 74:93–97.
31. Dietrich RE. Oral proteolytic enzymes in athletic injuries. *Pennsylvania Medical Journal*. 1965; 68:35–37.
32. Trickett P. Proteolytic enzymes in athletic injuries. *Applied Therapeutics*. 1964; 6:647–652.
33. Mansfield LE, Ting S, Haverly RW, Yoo TJ. Hypersensitivity to papain. *Annals of Allergy*. 1985; 55:541–543.
34. Amazu LU et al. Anti-inflammatory activity of the methanolic extract of the seeds of *Carica papaya* in experimental animals. *Asi. Pac. J Trop. Med*, 2010; 884-886
35. Oloyede OI. Chemical profile of unripe pulp of *Carica papaya*. *Pak J Nutr* 2005; 4(6): 379-381.
36. Fekeye TO, Oladipupo T, Showande O, Ogunremi Y. Effect of *Carica papaya* extract on hypoglycemic agents. *Tropical Journal of Pharmaceutical Research*. 2007;6(1):671–678.
37. Kusemiju O, Noronha C, Okanlawon A. Effect of papaya bark extract on rats. *Nigerian Postgraduate Medical Journal*. 2002;9(4):205–209.
38. Priyadarshi A, Bhuwal R. Pharmacognosy and pharmacological activity of papaya leaf. *IJPSR*. 2018;9(10).
39. Baskaran C, Rathabai V, Velu S, Kubendiran K. Antimicrobial activity of papaya leaf extract. *Asian Pacific Journal of Tropical Disease*. 2012;2(2): S658–S662.
40. Stepek G, Behnke JM, Buttle DJ, Duce IR. Trends in parasitology. 2004;20(7):322–327.
41. Hettige, Sanath. "Carica papaya leaf extract in Dengue fever." *IMPA Journal* 9.01 (2015): 11-14.
42. Carvalho, Fernanda Antunes, and Susanne S. Renner. "III. Correct Names for some of the Closest Relatives of *Carica papaya* L.: A Review of the Mexican/Guatemalan Genera *Jarilla* and *Horovitzia*." *Molecular Phylogeny*,

Biogeography and an e-Monograph of the
Papaya Family (Caricaceae) as an Example of
Taxonomy in the Electronic Age (2013): 33.

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