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Carica Papaya: A Plant with Multiple Benefits for Human Health

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ABSTRACT:

In tropical and subtropical regions of the world, papayas are a well-liked and significant fruit tree. Around the world, people eat the fruit raw or processed, or as a vegetable and fruit combination. In addition to being tasty and healthful, the entire plant—including the fruit, pulp, seeds, bark, root, and peel—has therapeutic qualities. A disturbance in the ratio of prooxidants to antioxidants leads to oxidative stress, which in turn affects redox signalling and damages cells and tissues. It causes a variety of illnesses, such as cancer, chronic diseases, aging skin, inflammation, and poor wound healing. However, these ailments can be effectively treated with the help of antioxidants. Because papaya is high in vitamins A, B, and C as well as proteolytic enzymes with antiviral, antifungal, and antibacterial qualities like papain and chymopapain, it has many health benefits. The papaya fruit plant is currently valued as a valuable neutraceutical due to significant advancements in knowledge about its biological activity and potential medical uses in recent years.

Keywords: Carica papaya, Indian herbs, Pharmacological uses.

Introduction:

A member of the Caricaceae family is the herbaceous plant Carica papaya. The papaya plant is well-known for its massive, melon-like fruit, which has bright orange flesh and numerous black seeds in the center. [1] Papaya is a year-round vegetable that is a nutritional powerhouse. Three powerful antioxidants, vitamins C, A, and E, are abundant in it. the minerals magnesium and potassium, fiber, folate, and vitamin B pantothenic acid. [2] It also has papain, a digestive enzyme that helps heal sports injuries, allergies, and trauma-related illnesses. As a whole, papaya's nutrients strengthen the heart, guard against heart conditions, heart attacks, and strokes, and shield against colon cancer. [3] The root, stem, leaves, flowers, and fruits of the Carica papaya plant, often known as papaya, each have unique physical characteristics. [4,5,6]

The morphology of the many components of the papaya plant is summarized as follows: -

Fig. 1. Parts of Carica papaya

a) Leaf: Papaya leaves are spiral-shaped, large, and lobed palmately at the apex of the stem.
They are shaped like fingers of a hand, with deep divisions into several lobes. Usually, the leaves are green in hue.

b) Stem: Papaya plants usually have a single, straight, unbranched stem. It has a cylindrical shape, is green, and is succulent. The stem is unique because of the wounds left by falling leaves.

c) Flower: Because papaya plants contain separate male and female parts, they are dioecious. The flowers have five petals, are aromatic, and big. Male Flowers: These flowers usually have long stalks with stamens and are borne in bunches. Female Flower: Larger and with a bulbous ovary at the base that eventually turns into the fruit.

d) Fruits: The papaya plant's most famous component is its fruit. Papaya fruits usually have smooth skin that changes from green to yellow or orange as they ripen. They can also be long, pear-shaped, or cylindrical. Juicy and sweet, the flesh has an orange hue. The fruit has several black seeds inside its center cavity.

e) Seed: Papayas have tiny, rounded, black seeds. Within the fruit's interior cavity, they are covered with a gelatinous material. Although they taste peppery, the edible seeds are frequently thrown away.

f) Latex: Usually, the latex is colored a milky white. It is viscous and sticky in consistency. In the parenchyma tissues of several plant sections, including the green fruit, stems, and leaves, are lactifer cells that secrete latex.

g) Root: The roots of papayas are usually shallow and fibrous. The primary functions of the roots are to support the plant and to draw water and nutrients from the soil.

Chemical constituents of Carica papaya whole parts:

The many chemical components found in papayas, including their fruit, fruit juice, seed, root, leaves, bark, and latex, are listed here. [7,8,9]

- Fruit: - Protein, lipids, fiber, carbs, minerals (calcium, iron, vitamins A, B, C, & E, thiamine, rivoflavin, niacin, carotene, amino acid, citric acid, and malic acids) from green fruits, volatile chemicals (benzylisothiocynate, cis and trans 2, 6-dimethyl-3,6 epoxy-7 octen-2-ol, alkaloids, carpaine).
- Leaf: - Alkaloids, flavonoids (quercetin, kaempferol), carpain, pseudocarpain, choline, vitamins C and E, dehydrocarpaine I and II, carboside.
- Seed: - Fatty acids, crude protein, carotenoids, crude fiber, carpaine, caricin, glucotropacolin, papaya oil, and myrosin anzyme.
- Bark: - Carpaine, caricin, glucotropacolin, fatty acids, crude protein, crude fiber, and an enzyme called myrosin is present.
- Root: - Carposides as well as the myrossin enzyme.
- Juice: - The lipids N-butyric, N-hexanoic, and N-octanoic acids; myristic, palmitic, stearic, linolenic, linoleic, and oleic acids.
- Latex(milk): - Peptidase A and B, lysozymes, papain, proteolytic, and chemopapain are present.
- Stem: - The Carica papaya stem contains alkaloids, tannins, saponins, and steroids, among other phytochemicals.

A plant with multiple benefits for human health:

It is a tropical fruit tree that has several health advantages in addition to being delicious taste. The following are some possible health advantages connected to different papaya plant components. [10,11,12]

Carica papaya plants are used in ancient traditional Ayurveda: -

Sr. No.	Parts of the plant	Medicinal use
1.	Papaya Leaves	Vermifuge, dengue fever, gonorrhea, anti-diabetic, jaundice, asthma, beriberi, fever, use in skin and hair scalp, gas, stomach bloating, heartburn, anti-inflammatory properties, abortion, platelets count increase, and dressing wounds (fresh leaves).
2.	Papaya flower	Jaundice, Febrifuge, Pectoral properties, antioxidant, cholesterol prevention, cough.
3.	Papaya stem bark	Anti-fungal, Jaundice, Anti-haemolytic activity, Sore teeth.
4.	Papaya root	Anti-fungal activity, Checking irregular bleeding from the uterus, Diuretics, and Piles.

5.	Papaya ripe fruits	Expectorant, reduce risk of heart disease, diabetes, cancer, lower blood pressure, bleeding piles, sedative and tonic, ringworm, stomachic, wounds of urinary tracts, chronic diarrhoea, dysentery, diuretics, and carminative.
6.	Papaya unripe fruits	Diuretics, anti-bacterial, used in snakebite to remove poison, abortion (abortifacient).
7.	Papaya seed	Paste in treatment of ringworm, psoriasis, destroys parasites, is a counter-irritant, anti-fertility agent in males, carminative, kills intestinal parasites, helps filter excess waste and cleans kidneys, has anticancer properties, and reduces inflammation.
8.	Papaya latex (milk)	Wound-healing, burn healing, treatment of pain, constipation, dysmenorrhea, papain (break down protein).

1. Platelet count: - When compared to the control group, the test group's platelet and red blood cell counts were significantly higher with fresh C. papaya leaf extract. Thus, it is critical to determine the compounds present in C. papaya leaves because they may be employed as a drug to improve erythropoiesis and thrombopoiesis in animals and humans whose cell lineages have been damaged.

2. Anti-oxidant activity: - In mice given an oral dose of 100 mg/kg, the effects of a methanolic extract of unripe C. papaya fruits on the activities of several antioxidant enzymes, such as glutathione peroxidase (GPx), glutathione transferase (GST), glutathione reductase, catalase, and glucose-6-phosphate dehydrogenase, were assessed in vivo. The ethyl acetate fraction causes a notable rise in the activities of glucose-6-phosphate dehydrogenase, GST, GPx, and glutathione reductase. A significant decrease in GPx was observed in the kidney following administration of ethyl acetate fraction. It has been proposed that the antioxidant potential may be attributed to quercetin and β-sitosterol.

3. Anti-diabetic activity: - In diabetic rats, the Carica papaya aqueous extract (0.75 g and 1.5 g/100 mL) effectively lowered blood glucose levels ($p<0.05$). Additionally, it lowered blood levels of aminotransferases, triacylglycerol, and cholesterol. After therapy, low plasma insulin levels in diabetic rats did not alter, but in non-diabetic rats, they climbed dramatically. In rats treated with diabetes, C. papaya could support islet regeneration as evidenced by the preservation of cell size. In contrast, pancreatic islet cells were normal in non-diabetic treated animals. C. papaya inhibited hepatocyte disruption and glycogen and fat buildup in the liver of diabetic rats.

4. Anti-malarial activity: - Alkaloids and flavonoids were found in the active time windows by profiling. Nine compounds in all were isolated. There were four identified flavonols: nicotiflorin, rutin, clitorin, and manghaslin. Five piperidine alkaloids were separated from the alkaloidal fraction. Three alkaloids, compounds 7–9, demonstrated strong antiplasmodial action and low cytotoxicity, while compounds 5 and 6 were inactive carpamic acid and methyl carpamate. Carpaine (7) was tried on mice harboring Plasmodium berghei, and it did not extend the duration of animal survival.

5. Anti-sickling activity: - Under osmotic stress conditions, the methanolic extract of C. papaya at a concentration of 10 mg/mL in vitro decreased hemolysis and preserved the integrity of the erythrocyte membrane.

6. Anti-tumor activity: - For many years, ethnomedicine has employed various portions of Carica papaya Linn. (CP) to treat a variety of illnesses, including cancer. Anecdotes of people with advanced malignancies going into remission after consuming CP leaf-based tea extract have been reported. It is yet unknown, though, exactly how CP tea extracts work on a cellular level. Examining the impact of aqueously extracted CP leaf fraction on the proliferation of different tumor cell lines and the antitumor effect of human lymphocytes is the goal of this study.

7. Anti-fungal activity: - Candida albicans growth is inhibited by carica papaya latex. It seems that latex proteins are the cause of this antifungal action. It was calculated that a protein concentration of at least 138 µg ml-1 was required to produce a full inhibition. Examining several glycosidic activities reveals that the only two glycosidic activities partially isolated and present in latex at significant quantities are α-D-mannosidase and N-acetyl-β-D-glucosaminidase. A restricted inhibition of yeast growth is observed by both enzymes, with α-D-mannosidase being more effective than N-acetyl-β-D-glucosaminidase.

8. Anti-microbial activity: - The extracts outperformed the gram-negative bacteria in all tests against gram-positive bacteria, with Pseudomonas aeruginosa exhibiting the highest activity (4.2 mm zone of inhibition). An increase in temperature increased the extracts' activity, whereas an alkaline pH reduced it. The root extracts had minimum inhibitory concentrations (MIC) and minimum bactericidal concentrations (MBC) ranging from 50 to 200 mg/ml. According to preliminary phytochemical tests, the extracts include glycosides, phenols, alkaloids, tannins, and saponins. Wound infections, otitis media, uretritis, and gastroenteritis can all be treated with carica papaya.

9. Anti-hypertensive activity: - The unripe papaya fruit (Carica papaya) was processed to create a crude ethanol extract. In mice given i.p. treatment, lethality experiments revealed a dose-mortality relationship with an LD50 of 325.2 mg/kg. Albino man Three groups of fifteen Wistar rats each—renal, DOCA-salt hypertensives, and normotensives—were randomly assigned. Three groups were created from each batch: the untreated, hydralazine-treated, and extract-treated groups. According to the findings, the basal (control) MAP in the normotensive, renal, and DOCA-salt hypertensives were 93.8 ± 4.5, 175.2 ± 5.1, and 181.3 ± 6.2 mmHg, respectively. In all groups, both hydralazine (200 µg/100 g i.v.) and extract (20 mg/kg. i.v.) significantly decreased MAP ($p < 0.01$ vs controls); however, in the hypertensive groups, the extract

significantly reduced MAP more than hydralazine. The extract did not lower blood pressure in another set of rats after propranolol pretreatment, but it did not stop the extract's effect on blood pressure when atropine and noradrenaline were pretreated.

10. Wound healing activity: - Using excision and dead space wound models, the aqueous extract of C. papaya fruit [100 mg/kg. bw) for 10 d] was tested for its ability to promote wound healing in streptozotocin-induced diabetic rats. When compared to the controls wound, which contracted by 59%, the aqueous extract exhibits a 77% reduction in the wound area. According to the results, C. papaya's aqueous extract demonstrated strong wound-healing capabilities.

11. Anti-inflammatory: - Rats with cotton pellet granuloma, formaldehyde-induced arthritis, and carrageenan-induced paw oedema were used to test an ethanolic extract of Carica papaya leaves. The reference group got 5 mg/Kg of indomethacin, whereas the experimental animals were given 25–200 mg/Kg of the extracts or saline (control group) orally. Investigations were also conducted into the extract's ulcerogenic potential. In the carrageenan test, the extracts considerably ($p < 0.05$) decreased paw edema, according to the findings. Similarly, the extract resulted in a noteworthy decrease in the quantity of granuloma formation, which went from 0.58 ±0.07 to 0.22 ±0.03 g. From the fourth to the tenth day of the study, the extracts dramatically decreased persistent edema in the formaldehyde arthritis model. At large doses, the extracts also caused a little irritation of the mucosa. The research validates the anti-inflammatory properties of papaya leaves from Carica.

12. Cardiovascular activity: - Male rats were used to study the central effects of an alcoholic extract of Carica papaya leaf. The extract produced a dose-dependent sedative effect (≥ 10 mg kg−1, i.p.). Additionally, the extract (≥ 5 mg kg, i.p.) relaxed the central muscles. An early desynchronization of the electroencephalogram (EEG) and an increase in electromyogram (EMG) activity were linked to the extract's behavioral effects. The optic chiasma then displayed a deactivating pattern and decreased EMG activity. Rats administered with doses of ≥50 mg kg−1 (i.p.) were shielded from seizures caused by pentylenetetrazol by the extract, whereas doses of 5 mg kg−1 (i.p.) provided 50% protection. Additionally, the extract provided 100% protection against maximal electroshock-induced convulsions at dosages of 100 and 200 mg kg−1 (i.p.).

13. Hepatoprotective activity: - Rats' hepatoprotective response to Carica papaya ethanol and aqueous extracts has been studied. The C. papaya aqueous and ethanol extracts demonstrated a notable hepatoprotection against hepatotoxicity generated by carbon tetrachloride. Biochemical markers such as serum bilirubin, aspartate aminotransferase, alanine aminotransferase, and alkaline phosphatase were used to assess the protective efficacy.

14. Anti-fertility activity: - Ethanolic leaf extract of C. papaya results in decreased sperm count, sperm motility, and seminal pH while sperm mortality and abnormalities of spermatozoa rose significantly ($p<0.05$). The length of treatment days affected these effects. Crucial elements of fertility include the normal range of sperm count, sperm motility, seminal pH, and abnormalities of spermatozoa. Any deviation from this typical range of seminal quality could have an impact on an animal's ability to reproduce. Therefore, these alterations in the seminal quality of the rats treated with C. papaya leaves demonstrated that the plant has antifertility properties, however, this does not always translate to a similar impact in people.
    As a result, its impact on human fertility can be further verified.

15. Anti-ulcer activity: - Rats with stomach ulcers caused by ethanol and indomethacin were used to test the anti-ulcer properties of aqueous and methanol extracts of whole, unripe Carica papaya fruit. Investigations were also conducted into the extracts' impact on small intestine propulsion. In comparison to the control group, the extracts considerably ($P<.05$) decreased the ulcer index in both experimental models. While AE was more successful in preventing stomach ulcers brought on by ethanol, I demonstrated superior defense against indomethacin-induced ulcers. Additionally, intestinal motility was considerably ($P <.05$) reduced by the extracts, with ME exhibiting higher activity. After 24 hours, mice given oral doses of AE and ME up to 5,000 mg/kg did not show any evidence of acute toxicity or mortality. Terpenoids, alkaloids, flavonoids, carbohydrates, glycosides, saponins, and steroids are all present in the extracts of unripe C. papaya.

16. Anti-amoebic activity: - According to findings from an in vitro study on the antiamoebic activity of several Congolese plant extracts used in traditional medicine to treat diarrhea, out of 45 plant extracts examined, 35 (77.78%) showed antiamoebic activity and 10 (22.22%) showed no activity. The extracts from the root bark of Paropsia brazzeana, Cryptolepis sanguinolenta, Alchornea cordifolia, Hensia pulchella, Maprounea africana, Rauwolfia obscura, and Voacanga africana, as well as the leaves and stem bark of Psidium guajava, Dialum englerianum, Harungana madagascariensis, Mangifera indica, mature seeds of Carica papaya, and the leaves of Morinda morindoides and Tithonia diversifolia, demonstrated the highest activity ($MIC<100$ μg/ml).

17. Diuretics activity: - Sprague Dawley rats were given water extracts of Carica papaya and Ananas comosus orally at concentrations of 5 and 10 mg/kg. Commercial diuretics, furosemide, and hydrochlorothiazide were administered at a dose of 10 mg/kg to two different groups. Over four hours, measurements of urine volume, pH, density, and electrolytes were made every hour. The serum levels of creatinine, albumin, blood urea nitrogen (BUN), and glucose were measured after blood was drawn. Extracts from C. papaya and A. comosus both showed moderate to strong diuretic properties. At both 5 and 10 mg/kg, the urine volume after 4 hours was enhanced by C. papaya extract. Urine volume was only raised by A. comosus extracts at a dose of 10 mg/kg. Throughout the investigation, Na+ and Elimination remained constant. On the other hand, both plant extracts considerably raised the K+ excretions in the urine after four hours. When compared to controls, both plant extracts significantly raised serum BUN and creatinine levels ($p<0.05$).

18. Anthelmintic activity: - This study looked at the potential anthelmintic action of papaya latex against mice infected with Heligmosomoides polygyrus for experimental purposes. One hundred Heligmosomoides polygyrus infectious larvae per animal were injected into five groups of BALB/C mice. Four mouse groups—B, C, D, and E—were fed papaya latex suspended in water at doses of 2, 4, 6, and 8 g of papaya latex/kg body weight, respectively, following patency (day 22). The mice in group A were used as the untreated controls. For post-mortem worm counts, all animals were necropsied on day 25-, or three days following treatment. In groups B, C, D, and E, the papaya latex exhibited antiparasitic efficacy of 55.5, 60.3, 67.9, and 84.5%, respectively. The findings might point to papaya latex's possible use as an anthelmintic against mammalian hosts' patent intestinal worms.
19. Effect on smooth muscle activity: - Papaya seed ethanol extract, at concentrations ranging from 0.1 to 6.4 mg/mL, inhibited jejunum contraction in a concentration-dependent manner and was found to be significantly irreversible. Consequently, the extract can reduce the isolated rabbit jejunum's contractile strength.
20. Immune modulatory activity: - The chemical components of the C. papaya seed extract and its bioactive fractions were investigated in vitro utilizing complement-mediated hemolytic assays and tests for lymphocyte proliferation.

Conclusion: -

There is therapeutic value to the entire plant. The plant, C. papaya, is a neutraceutical plant because of its many vitamins and enzymes. The papaya offers a variety of pharmacological characteristics. According to custom, papaya has potent medicinal properties. The biological activities have been the subject of a substantial amount of research. The usage of chemical ingredients and all pharmacological activities are included in this overview.

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