A Review on Pharmacognosy, Phytochemistry, And Pharmacological Activity of Carica Papaya (LINN.) LEAF

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Abstract: Carica papaya (Linn.), commonly known as papaya, is a well-known tropical fruit plant recognized not only for its nutritional value but also for its wide range of medicinal properties. Over the years, its leaf has garnered significant attention for its diverse pharmacological potential. This review focuses on the pharmacognosy, phytochemistry, and pharmacological activities of Carica papaya **leaf. Pharmacognostically, papaya leaf displays characteristic morphological and microscopic features, which aid in its identification and standardization. The phytochemical analysis reveals that the leaves are rich in bioactive compounds, including alkaloids, flavonoids, saponins, tannins, and phenolic acids. These compounds contribute to a wide array of therapeutic properties such as antioxidant, anti-inflammatory, antimicrobial, and antimalarial activities. Pharmacologically, Carica papaya leaf has shown promising effects in managing various health conditions, including diabetes, cancer, gastrointestinal disorders, and dengue fever. In particular, the leaf extract is extensively studied for its role in increasing platelet counts, which is crucial in dengue management. This review consolidates the current understanding of the bioactive constituents of** Carica papaya **leaf, its pharmacological properties, and its potential therapeutic applications. The insights provided aim to stimulate further research on its medicinal potential and pave the way for new drug discovery from natural sources.**

Keywords: Carica Papaya (Linn.) Leaf

INTRODUCTION

Carica papaya (Linn.), commonly known as papaya, is a tropical fruit-bearing plant from the family Caricaceae. Native to the tropical regions of Central and South America, papaya has gained widespread recognition not only for its edible fruit but also for the therapeutic potential of its various parts, particularly the leaves. Over centuries, papaya leaves have been utilized in traditional medicinal systems across the world for the treatment and management of various ailments. With its extensive cultivation across tropical and subtropical regions, Carica papaya has become an important subject of research in the fields of pharmacognosy, phytochemistry, and pharmacology.Pharmacognosy, which involves the study of medicinal plants and natural sources, is instrumental in identifying and analyzing the bioactive components in papaya leaves. These leaves contain a diverse array of phytochemicals, including alkaloids, flavonoids, saponins, tannins, and phenolic compounds. These naturally occurring substances form the basis for the plant's pharmacological effects, providing both preventive and curative benefits against various diseases. Over the years, there has been an increasing interest in understanding the full scope of these bioactive compounds and their mechanisms of action, which hold promise for new therapeutic applications. From a phytochemical standpoint, Carica papaya leaves are rich in secondary metabolites that contribute to their medicinal properties. Some of the most significant compounds include papain, an enzyme known for its proteolytic activity; carpaine, an alkaloid with cardiovascular effects; and numerous phenolic acids, which exhibit antioxidant properties. These compounds are thought to work synergistically to provide a broad spectrum of pharmacological activities such as anti-inflammatory, antimicrobial, antioxidant, and immunomodulatory effects. In particular, papaya leaves have been noted for their effectiveness in boosting platelet counts in cases of dengue fever, as well as their potential anti-cancer, anti-diabetic, and hepatoprotective activities.In traditional medicine, the leaves of Carica papaya have been used to treat various health conditions such as

malaria, gastrointestinal disturbances, and skin infections.

FIG-01-CARICA PAPAYA (LINN.) LEAF

Pharmacologically, Carica papaya leaves have shown promise in several areas. Perhaps one of the most well-known applications is their role in the treatment of dengue fever, where the extract from papaya leaves is believed to aid in increasing platelet counts and improving recovery. The leaves also demonstrate hepatoprotective properties, making them a candidate for supporting liver health and protecting against liver damage caused by toxins. Additionally, papaya leaves have been studied for their anti-cancer potential, with some research indicating that compounds within the leaves may inhibit cancer cell proliferation and induce apoptosis (programmed cell death). Other studies have highlighted the leaves' antidiabetic properties, suggesting that they could help in regulating blood glucose levels and managing diabetes.This review seeks to provide a comprehensive overview of the pharmacognosy, phytochemistry, and pharmacological activities of Carica papaya leaves. By examining the bioactive compounds present in the leaves, as well as their therapeutic applications in traditional and modern medicine, this review aims to highlight the scientific underpinnings of papaya leaves' medicinal value. The exploration of their potential in treating conditions like dengue fever, cancer, and liver disorders not only supports their traditional uses but also opens up new avenues for research and development in natural product-based pharmaceuticals.

Pharmacognostical Studies: The papaya is a small, usually a single stemmed tree with sparsely branching. It grows from 15 - 30 ft tall having leaves spirally arranged and confined to the top. The lower trunk contains conspicuous scars of leaves and fruits. The leaves are deeply palmately lobed with seven lobes, large, 50 - 70 cm (20 - 28 in) in diameter. The trees are dioecious containing latex in all parts. The flowers are highly dimorphic having 5 parts and, the stamens fuse to the petals of male flowers. A superior ovary and five contorted petals remain present in female flowers. Male and female flowers remain in the leaf axils. The sweet-scented flowers remain open at night. It bears a large berry-like fruit with 10 - 30 cm diameter and 15 - 40 cm long. The analysis and documentation of Carica papaya Linn. leaves have been done for the development of quality standards. The microscopic study reveals the presence of epidermis, collenchymas and parenchyma, sclerenchyma, xylem, phloem, and pith was found to be absent. Successive extractive value has been found highest in petroleum ether extract 20.44%. Moisture content found to be 7.77% whereas mean ash values were 16.72% (total), 3.25% (acid insoluble ash) and 6.05% (water-soluble ash) . Abundance of spheraphides and rhomboidal calcium oxalate crystals and starch grains are reported in leaf powder. No trichomes found whereas the stomatal index was found to be 31.56 ± 3.41, vein termination number 3-4 and palisade ratio as 12.65 ± 1.57.14 20.

Phytochemical Studies: Phytochemical studies on *Carica papaya* (Linn.) leaf reveal a rich composition of bioactive compounds, which contribute to its pharmacological properties. The leaves are known to contain various secondary metabolites such as alkaloids, flavonoids, tannins, saponins, glycosides, and phenolic compounds. Each of these classes of phytochemicals plays a distinct role in the therapeutic potential of papaya leaf.

Key Phytochemicals Found in *Carica papaya* Leaf:

- Alkaloids: These are nitrogen-containing compounds that have significant pharmacological activities, including anti-inflammatory, analgesic, and antimicrobial properties.
- Flavonoids: Known for their antioxidant properties, flavonoids in papaya leaf help neutralize free radicals and reduce oxidative stress, contributing to its anti-inflammatory, hepatoprotective, and cardioprotective effects.

- Tannins: These are polyphenolic compounds with astringent properties. Tannins in papaya leaf exhibit antimicrobial and anti-inflammatory activities, as well as aiding in wound healing.
- Saponins: These compounds exhibit expectorant, anti-inflammatory, and immune-boosting properties. Saponins are also known for their ability to reduce cholesterol levels.
- Glycosides: Papaya leaf contains cardiac glycosides, which have shown potential in managing cardiovascular diseases by regulating heart rhythm and contraction.
- Phenolic Compounds: These are potent antioxidants that help in preventing cellular damage caused by oxidative stress, which is linked to various chronic diseases like cancer and diabetes.

Pharmacological Studies:

1. Antithrombocytopaenic Activities: One of the most notable medicinal uses of *Carica papaya* leaf is its effectiveness in managing thrombocytopenia, a condition characterized by abnormally low platelet counts. In tropical regions, where dengue fever is prevalent, the use of papaya leaf extract as an adjunct treatment to increase platelet counts has gained considerable clinical interest. Studies suggest that papaya leaf extract contains active compounds, such as flavonoids, alkaloids, and glycosides, which may stimulate platelet production or reduce platelet destruction.
2. Analgetic Activity: The three extracts of leaves of Carica papaya L. have been evaluated for their analgesic activity in mice models having acetic acid-induced pain (Siegmund method).These three extracts (n-hexane, ethyl acetate, and ethanol extracts) exhibited significant analgesic activity at all three dose levels (0.175, 0.35 and 0.70 mg/kg bw orally) when compared to aspirin (taken as the standard drug).
3. Antiplasmodial Activity: Leaf extracts of Carica papaya L. exhibit high antiplasmodial activity with low cytotoxicity. This activity is shown by three alkaloids . Compounds were tested for bioactivity in-vitro against four parasites (Trypanosoma brucei rhodesiense, Trypanosoma cruzi, Leishmania donovani, and Plasmodium falciparum), and in the Plasmodium berghei mouse model. This study concludes that the antiplasmodial activity of papaya leaves was confirmed and might be linked to alkaloids. Among these alkaloids, carpaine was highly active and selective in vitro.
4. Antitumor and Immunomodulatory Activity: A study has been completed to assess the antitumor and immunomodulatory activity of Carica papaya L. leaf aqueous extract. In this study, the effects of Carica papaya L. extract on the proliferative response of tumor cell lines were observed. Through [3H] thymidine incorporation the cytotoxic activities of human peripheral blood mononuclear cells (PBMC) was also assessed. Results were indicative of significant growth inhibitory activity of this extract on tumor cell lines. As far as PBMC concerned the leaf extract reduced the production of IL-2 and IL-4. The expression of 23 immunomodulatory genes was enhanced by this extract. Index markers of immunomodulatory effects were also found. Conclusively this study revealed that the Carica papaya L. leaf extract may mediate a Th-1 type shift in the human immune system. The extract may potentially provide a link for treatment of carcinoma, allergic disorders and serve as immuno modulator in human . The antiproliferative response of Carica papaya L. leaf juice has been assessed on a range of cell lines representing benign hyperplasia, tumorigenic and normal cells of prostate origin. A time course analysis of before and after in-vitro digestion and of the molecular weight based fraction of leaf juice showed significant antiproliferative response. The cytotoxic effect of medium polarity fraction of leaf juice (0.03-0.003 mg/mL) was seen on all prostate cells excepting of the normal cells. The medium polar fraction has also been found to inhibit migration and adhesion of metastatic PC-3 cells. The S phase cell cycle arrest and apoptosis were thought to be a possible mechanism for these activities on the basis of flow cytometric study.
5. Antidiabetic Activity: A study regarding the assessment of antidiabetic activity of Carica papaya L. leaf extract was carried out in an experimental rat model. The chloroform extract which consist steroid and quinines was adminis tered at various dose levels in streptozotocin

induced diabetic and non-diabetic rats. After 20 days of treatment, the sacrifice was done and the biochemical study was carried out. There was a significant reduction in serum glucose, trans aminases and triglyceride observed in diabetic rats after the administration of Carica papaya L. leaf chloroform extract.

6. Antimicrobial Activity: Numerous studies have demonstrated that extracts of *Carica papaya* leaves exhibit broad-spectrum antimicrobial properties, effective against a range of bacteria (e.g., *Escherichia coli*, *Staphylococcus aureus*), fungi (e.g., *Candida albicans*), and even some viruses. The antimicrobial activity is primarily attributed to the presence of phenolic compounds and flavonoids, which disrupt microbial cell walls and inhibit enzymatic activity, leading to pathogen death.
7. Anthelmintic Activity: The anthelmintic activity of *Carica papaya* leaf has been demonstrated in several studies, showing effectiveness against various parasitic worms. The bioactive compounds in the leaf, particularly alkaloids, flavonoids, and papain, have been shown to disrupt the life cycle of intestinal worms and prevent their growth and reproduction.

Key studies have shown:

- *In vitro* and *in vivo* experiments indicating a significant reduction in worm load in animals treated with papaya leaf extracts.
- Papain, due to its proteolytic activity, interferes with the structural proteins of helminths, causing paralysis or death of the parasites.
- Flavonoids and alkaloids enhance the leaf's efficacy by damaging the helminth cell membranes and disrupting their physiological processes.

CONCLUSION

Herbal products are preferred as a symbol of safeguard in comparison to synthetic one which shows various untoward effects on health. The present literature review supports the broadness of activity present in the leaves of Carica papaya. The advanced phytochemical analysis entails us the presence of a variety of active molecules which may be responsible for its various biological activities. More research can be done to explore the unknown and unexplored potential of leaves of Carica papaya L. Further analysis of leaves of Carica papaya L. (active compounds) can be carried out by way of making use of different advanced investigative methods.

Conflict Of Interest: We declare that we have no conflict of interest.

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