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Phytochemical, Pharmacognostical and Pharmacological Activities of *Carica papaya*

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ABSTRACT

The nutritional and medicinal benefits of papaya (Carica papaya Linn.) have long been known. Many traditional medical systems, such as Ayurveda, recognise papaya's medicinal potential. Traditional literature has used it to treat fever, swellings, bilious fever, gonorrhoea, eczema, rheumatism, headache, whooping cough, asthma, chickenpox, and bronchitis. A vital nutraceutical agent has been identified after four decades of remarkable research on its biological activity and medical applications. The leaf of Carica papaya Linn. has antibacterial, antipyretic, insecticidal, antimicrobial, and antimolluscan effects. Phytoextraction of heavy metals, phytoremediation of particle pollution, and other modern approaches have been utilised to study leaves. Phytoconstituents and leaf composition have been studied for decades. Carica papaya is used to cure a variety of diseases including malaria, dengue fever, inflammation, and skin infections. The antioxidant and antibacterial activity of C. papaya flowers were first assessed using TLC screening and UV spectroscopy. The extracts were also analysed by TLC and UV-visible spectroscopy. The methanol extract included the greatest alkaloids, flavonoids, saponins, and tannins, according to the screening results. Both chloroform and n-hexane extracts had saponins and tannins, while n-hexane also had steroids and flavonoids. It had flavonoids, tannins, saponins, and phenolic chemicals.

Keywords- *Carica papaya*, Pharmacognosy, Pharmacology, Phytochemistry, Ethanopharmacology.

I. INTRODUCTION

The nutritional and therapeutic characteristics of papaya (Carica papaya Linn.) Traditional medicine systems like Ayurveda recognise the healing properties of papaya fruit and other parts. It is said to treat headaches, whooping cough, asthma, chickenpox, and bronchitis, among other diseases[1]. A key nutraceutical agent has been the subject of great research for over 40 years. The antibacterial, antipyretic, insecticidal, antimicrobial, and antimolluscan properties of Carica papaya Linn. Phytoextraction for heavy metals, phytoremediation for particle pollution, and others are now used to analyse leaves. Scientists have been studying phytoconstituents and leaf composition for decades. Carica papaya is used to treat malaria, dengue fever, inflammation, and skin infections. First, the C. papaya flowers were screened for antioxidant and antibacterial activities using TLC and UV spectroscopy[2,3]. TLC and UV-visible spectroscopy were used to analyse the extracts. The methanol extract included the greatest alkaloids, flavonoids, saponins, and tannins, according to the screening results. n-hexane extracts contained saponins, but also steroid and flavonoid compounds. This extract contained flavonoids, tannins, saponins, and phenolic compounds[4,5].

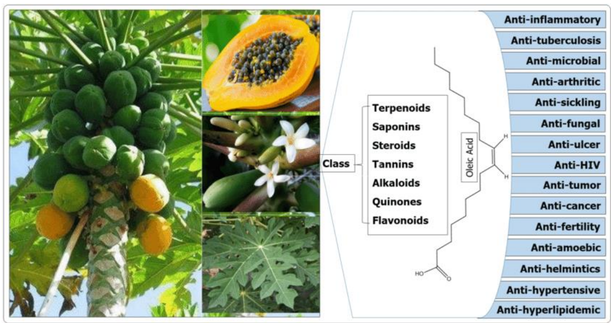

Fig 1 : Medical properties of Papya

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II. DISTRIBUTION AND BOTANICAL DESCRIPTION

Geographical distributions

It is possible to find papayas in the United States of America, Mexico, and Costa Rica, as well as in the Caribbean islands of Grenada and Colombia; the native Papaya ranges are Grenada and Colombia; the Caribbean islands of Grenada and Colombia; and the Caribbean islands of Grenada and Colombia; as well as the Caribbean islands of Guadeloupe and Dominica; the Caribbean islands of Grenada and Colombia; as well as Grenada and Colombia[6].

Taxonomy

Papaya (Caricaceae family, Brassicales order) is a perennial and blooming plant. Papita, Papaya, Omakai, Pepe and Eerankari are just some of the prevalent names for the plant in India. In Australia, the pawpaw plant is known as mamo; in Brazil, as fruta bomba; in Cuba, as fruta papaya; in Holland, as tree melon; in Colombia, as papayo; and in the U.K., as papaya plant. C. papaya's botanical categorization is outlined in the following manner[7].

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Brassicales
Family	Caricaceae
Genus	Carica
Species	Papaya L.

Morphological Characteristics of Papaya

Despite its appearance, the papaya is actually a herb, albeit one that has a different structure and looks more like a tree. Papaya is the most popular name for C. papaya. Papye, Pawpaw, Lapaya, Tapayas, and Kapaya are some of the other names for this plant. Unlike trees, papayas stand upright and are herbaceous rather than woody in appearance[8]. Compound leaves are seen here. The average diameter of the leaf is between 50 and 70 centimetres, and the leaves have a palm-shaped morphology. It is common for papaya flowers to be dioecious. Depending on the flower, the resulting fruit might take on a variety of shapes. A straw-colored male bloom is typical. The corolla tube is a cylinder with a diameter of 2 centimetres. The racemose form of female flowers is used. Yellowish-orange in colour, the fruit is 5–30 centimetres long. The pulp of this fruit, which is delicious and contains many black seeds, is inedible[9-10].

Roots: There are distinct layers of endodermis, epidermis, and cortex in the early roots of papaya plants. These layers are dense and nonaxis[11].

Stem: From the base to the crown, the stem has a soft, hollow, and cylindrical trunk that is 30 cm in diameter. Normally, papaya trees have a single trunk and a canopy of large palmate leaves growing from the tip of the trunk, but they can have several trunks if they are damaged.

Leaves: The leaves measure between 50 and 70 centimetres broad. A big palmate leaf with 5-9 pinnated lobes, ranging in width from 40-60 cm, is the plant's most distinguishing feature. The leaves are spirally arranged and clustered in the branches of mature trees[12]. When cavitation resorting, the copious starch endodermis in the leaf's dorsiventrally located endodermis, which extends from 30 cm to 105 cm in length, may be important to the leaf's dorsiventral position and length. Squishy mesophyll, on the other hand, is composed of 4-6 cell layers, whereas palisade parenchyma and epidermis in the leaf are constructed of a single layer of cells. Drusy grains and reflective granules fill the leaves (calcium oxalate crystals). When it comes to papaya leaves, the stomata on the bottom of the leaves have anisocytic stomata or no subsidiary cells[13-15]. Stomatal density of 400/mm sq. can be altered by environmental factors like water, temperature, and light. The leaves are lighted by sunshine. Xylem and phloem were found to be present in the leaf, while pith was found to be lacking from the microscopy of the leaf. The ventral and dorsal views of a C. papaya leaf are shown in Fig (2).

Fig 2 : Leaves of Papaya

Flowers: To describe the 'trioeciousness' of C. papaya flowers is to say that distinct plants can produce either male, female or bisexual blooms. When closed, the flowers of the female papaya have a pear shape, whereas the long stalks of the male papaya support little blooms, and the tubular flowers of the bisexual papaya[16]. Bisexual plants are generally superior to male or female plants in terms of quality and preference. There is just one central axis through which the flowers are organised in the cluster, and they are actinomorphic, bracteolate and stationary. Ten stamens in two whorls comprise the androecium, which is epipetalous (on the petals or corolla). It has bilocular anthers that are both introrse and bilocular[17]. There are five petals in the corolla that are long and yellow in colour in the calyx

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(gamopetalous) and the five petals in the corolla that are small and joined (gamosepalous). The androecium is absent from female flowers, which only have an ovary and stigma. Male or pistillate flowers have bracteolate petals. In pistillate flowers, the androecium is missing, and the gynoecium is sessile. The ovary is superior, with an infinite number of seeds, and has a short style with a five-lobed stigma[18-20].

Fig 3 : Flowers Papaya

Fruits: Large, oval plant fruits are sometimes referred to as "pepo-like berries" because of their melon-like shape and the presence of a seed cavity in the centre. On the main stem, fruit is borne axillary and is usually borne individually, but in clusters can also be found[21]. In addition to its flavour, colour, and scent, fruit pulp offers a wide range of chemical, nutritional, and digestive qualities Fig 4. Depending on the cultivator and climate, plant fruits take anywhere from 5 to 9 months to mature. It's green until it's ripe, turning yellow or red-orange, and the fruit flesh is yellow-orange to pinkish orange when it's mature[22]. Fruits can be oval or spherical in shape and are berries with seeds inside the fruit cavity. The unripe fruit had a thick cuticle, laticifers, epicarp parenchyma, mesocarp endocarp, and calcium oxalate crystals visible under a microscope, according to the research[23-25].

Fig 4: Papaya fruit

Seeds : Papaya plants are often propagated by the use of seeds. Oval and flat cotyledons and the endosperm of plant seeds are blackish to brownish in hue. The fruit's inside chamber is filled with a mucilaginous material that coats many black seeds. The seeds are edible, with a spicy flavour and antimicrobial characteristics that help prevent kidney failure caused by the toxin[26].

III. PHYTOCHEMICAL INVESTIGATION

The analysis of C. papaya fresh flower extract in various solvents was performed using standard protocols with slight changes as follows[27].

Test for alkaloids

The plant extracts (3 ml) were infused with HCl and then steamed for a few minutes. Some Mayer regent was then added to the mixes. Turbidity is a sign that alkaloids are present[28].

Test for flavonoids

The stock solution of C. papaya extracts was diluted with sodium hydroid solution and a few drops were added (0.5 ml). The plant crude extract had a strong yellow colour, which turned colourless when diluted H_2SO_4 was added, indicating the presence of a flavonoid[29].

Test for saponins

Test tube was shaken by hand for 15 minutes with stock solution from each crude extract C. papaya flowers (0.5 ml). Saponin was detected in the test tube by the creation of a foam layer at the top[30].

Test for steroids

Concentrated sulfuric acid (1 ml) was poured into the test tube through the walls after the plant extracts were dissolved in chloroform (10 ml). Fluorescent green tinged the sulfuric acid layer, which had previously been yellowish. Steroids were clearly present in this sample[31].

Test for tannins

It was mixed with distilled water and two millilitres of extract were added and swirled in. Solution of ferric chloride was added. The presence of tannins was demonstrated by the production of a green precipitate[32].

Test for phlobatannins

HCl hydrolyzed two millilitres of extract, and then the solution was heated for a few minutes. Phlobatannins are present when red precipitation forms.

Test for glycosides

Using chloroform and acetic acid, two millilitres of extracts were dissolved, followed by a few drops of sulfuric acid, and the colour change from blue to green was noticed[33].

Thin layer chromatography

Chloroform: methanol (80:20) was utilised as the mobile phase in thin-layer chromatography. TLC tests were performed in a controlled environment with a temperature of RT and a relative humidity of 60%. A UV chamber (254 nm) was used for a short time to observe the varied spot positions of the compounds on

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the TLC plates (Merck-silica gel 60 F_{254}). Standard formullion was used to calculate the plant extract Rf value[34].

UV-visible spectroscopy

They were scanned by the spectrophotometer using UV-Vis light (Shimadzu, UV-1800). Plant extracts were produced in particular solvents at a final concentration of 0.10 mg/ml using methanol, chloroform, n-hexane, and aqueous solvents as blanks. It was scanned between 800 and 200 nm[35].

DPPH radical scavenging assay

A standard technique 1,1-diphenyl-2-picryl-hydrazyl (DPPH) experiment was used to determine the C. papaya flower's antioxidant and free radical scavenging abilities. An antioxidant chemical contributes an electron to DPPH, causing its colour to change from deep violet to yellow, and DPPH is possible to oxidise through decolorization of methanol solution. 95 percent methanol was used to prepare the DPPH solution, 0.1 mM[36]. The extracts' stock solution was likewise produced in methanol at a concentration of 95%. The stock solution was then divided into five test tubes, each containing 2 ml, 4 ml, 6 ml, 8 ml, and 10 ml, each of which was diluted in the same solvent to a final concentration of 20 µl/mg, 40 µl/mg, 60 µl/mg, 80 µl/mg, and 100 µl/mg. DPPH solution was added to each test tube with 1 ml of the sample extracts and 2 ml of fresh DPPH solution was added to each test tube. Methanol was utilised as a control. Absorption at 517 nm was measured after 30 minutes of incubation in darkness at room temperature using a spectrophotometer. In the past, ascorbic acid was the standard.

IV. PHARMACOLOGICAL STUDIES

i. Anti-inflammatory and immunomodulatory effects

It's been reported that papaya's pulp, leaves, and seeds may have anti-inflammatory and immunomodulatory properties. Study participants who ate papaya fruit showed a decrease in IFN-+CD4+ T cells, which play a critical role in inflammatory responses, after the fruit was consumed. Carrageenan-induced paw oedema, cotton pellet granuloma, and formaldehyde-induced arthritis in rats were all considerably reduced by papaya leaf extract. Anti-tumor immunity-related cytokines (IL-12p40, IL-12p70, IFN-λ or TNF-α) from human cells were also found to be enhanced by the leaf extract's immunomodulatory properties. Similarly, human blood cells isolated from the seed extract showed increased phytohemagglutinin reactivity when exposed to the extract. As a result, the seed extract is likely to contain immunomodulatory chemicals or components with growth-promoting properties. Using an in vitro classical complement-mediated hemolytic pathway experiment, some bioactive fractions of the seed extract are found to have the ability to suppress cell lysis[37]. This suggests that it may have an anti-inflammatory effect. Flavonoids, saponins, tannins, and glycosides in papaya, especially the leaves, have been linked to a range of anti-inflammatory effects. One or a combination of identified elements may be responsible for the anti-inflammatory actions.

ii. Anticancer effects

Papaya is a potential source of glucosinolates, isothiocyanates, and BITC, all of which have been shown to have cancer-fighting properties. Studies have shown that BITC inhibits tumour growth by inducing apoptosis in cancer cells. Anticarcinogenic properties of isothiocyanates may be linked to their ability to stimulate phase II enzymes such glutathione S-transferase, nicotinamide ADP and quinine reductase, according to some researchers[38]. Since the discovery of cancer-preventive properties of plant glucosinolates, plant sources have been of tremendous interest. Plant-specific myrosinase or human gut flora are known to breakdown glucosinolates into isothiocyanates. Intriguingly, the antitumor effects of C. papaya leaf extract on tumour cell lines were only recently discovered. Solid tumour cell lines generated from cervical carcinoma, breast adenocarcinoma, prostate cancer, hepatocellular carcinoma, lung adenocarcinoma, pancreatic epithelioid carcinoma, and mesothelioma were demonstrated to be greatly inhibited in their proliferation by the leaf extracts. According to these studies, leaf extracts have been shown to have anticancer qualities and may one day be used to cure and prevent certain human diseases like cancer and to boost the immune system in the context of vaccination therapy. Isothiocyanates derived from papaya fruits have been confirmed to work as a glutathione S-transferase inducers, however there is no current scientific data on the exact molecule that demonstrated the anti-cancer and immunological modulating benefits. One study found that Papya leaf fractions with molecular weights less than 1000 might boost production of the Th 1 cytokines and inhibit the growth of tumour cell lines, with the potential to protect against a variety of allergy illnesses. Lycopene concentration was also high in papaya fruit. Lycopene has been shown to cause apoptosis in human cancer cells in vitro, particularly prostate cancer cell lines, suggesting that it may have therapeutic potential as a chemotherapeutic agent[39].

iii. Wound healing effects

When it comes to treating skin conditions, papaya's wound healing qualities have been studied in detail in animal research. Mature green fruit (unripe) peel extract has shown faster epidermal wound healing in mice and rats than ripe fruit peel extract. Latex from the skin was also used to evaluate wound healing in mouse burn models. However, the latter theory indicated that latex was responsible for the healing powers of the latex. Papain, chymopapain A and B, caricain, papaya endopeptidase II, papaya endopeptidase IV, omega endopeptidase chitinase II, protease inhibitors, glutaminyl cyclase, and other unknown-function proteins are found in the latex of unripe papaya fruits. Many

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proteolytic enzymes have been shown to be beneficial in debriding necrotic tissues, preventing infection, encouraging development, and enhancing scar quality. Examples include papain, chymopapain, and leukopapain. Consequently, papaya has a significant potential for healing wounds in accordance with traditional beliefs[40].

iv. Anti-ulcer effects

To prevent stomach ulcers, papaya leaves and unripe fruits may be an effective treatment. Rats pre-treated with papaya extracts had a much lower stomach ulcer index than those given alcohol and the conventional medications cimetidine and indomethacin respectively. This fruit's capacity to slow down digestion has also been demonstrated. Increasing the absorption of oral anti-ulcer medicines has been found to be effective in ulcer therapy by delaying gastrointestinal motility. In addition, antibacterial characteristics of the unripe fruit have been demonstrated, which may help treat or prevent stomach ulcers by acting on Helicobacter pylori. Terpenoids, alkaloids, flavonoids, carbohydrate glycosides, saponins, as well as steroids are found in the extracts of C. papaya that are not yet mature[41]. One of saponin's anti-ulcer properties is the production of protective mucus on the gastric lining and protection of that lining from stomach acid by that lining. The anti-ulcer effect of the leaves and unripe fruit may be explained by the extracts' cytoprotective and antimotility characteristics.

V. CONCLUSION

In contrast to synthetic products, which have been shown to have a variety of harmful impacts on health, herbal products are seen as a symbol of protection. Carica papaya leaves have a wide range of activities, according to this research study. Using an advanced phytochemical study, we can identify a wide range of active chemicals that may be responsible for the plant's numerous biological functions. Leaves of Carica papaya L. need to be studied further to discover their full potential. Further investigation into the active chemicals in Carica papaya L. leaves can be carried out by utilising a variety of cutting-edge investigative approaches. Plants known as C. papaya can be found growing all over the world. They have a wide range of nutrients in different portions of the plant that have been used for medicinal purposes for centuries, as well as in modern times. Several disorders can be treated with papaya's proven pharmacological effects (such as anti-inflammatory, antioxidant, antibacterial, and immunomodulatory activity). Commercial medications, for example, are available to treat dengue fever.

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