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Pharmacological Review of Carica Papaya

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Abstract: ***Papaya (Carica papaya Linn.) is a fruit that belongs to the Caricaceae family and is well-known for its medicinal and nutritional benefits all over the world. The components of the papaya plant have been utilized for medicinal purposes since ancient times. Herein, we aimed to review the medicinal and pharmacological activities of papaya and focused on the different properties of papaya as a multi-faceted plant. Papaya plants have been increasingly investigated and have shown great pharmacologic promise as a result of their antioxidant, anti-inflammatory, anti-malarial, and antimicrobial properties. It was also reported that transgenic and native papaya fruit (both ripe and unripe) have significant immune-modulatory properties. The extracts from the fruit, seeds, and leaves of the selected plant have also been shown to have significant cytotoxic activities against cancer cell lines including breast, liver, and cancer of hematopoietic cell lines. The papaya plant demonstrated potent medicinal activity to a certain extent and could be of nutraceutical importance for food industry applications.***

Keywords: *Carica* papaya L.; Medicinal activity; multi-faceted plant; Nutraceutical; Pharmacological activity

Introduction

The papaya (*Carica papaya Linn*.) is one of the most widely grown plants in tropical regions, as well as the most popular and commercially important Caricaceae species. It is a species of flowering plant that is native to India, Malaysia, Indonesia, the Philippines, and Sri Lanka including Oman. Several Asian countries have cultivated papaya on a commercial basis. In some tropical countries, papaya is also cultivated as a garden plant. Papaya contains a broad spectrum of phytochemicals including polysaccharides, vitamins, minerals, enzymes, alkaloids, glycosides, saponins, sterols, etc. The plant is recognized by its weak and usually unbranched soft stem yielding copious white latex and crowded by a terminal cluster of large and long-stalked leaves, is rapidly growing, and can grow up to 20m tall. .[1]

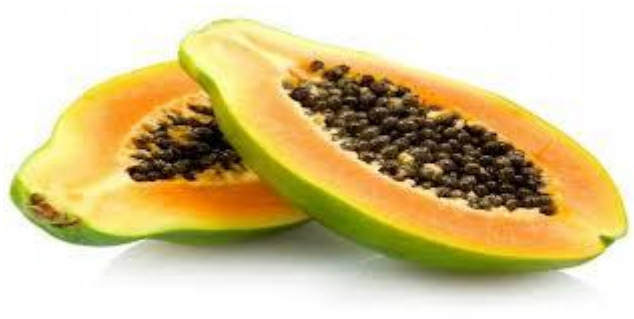

Figure 1: *Carica papaya* fruit

Literature Survey

A literature survey was done in Google Scholar using keywords *C.papaya*, taxonomy and morphology of *Carica papaya*, phytoconstituents of papaya plant, nutritional value of *Carica papaya*, medicinal and pharmacological properties of papaya, antioxidant activity, anticancer activity, anti-inflammatory activity, antimalarial activity, anti-diabetic effects of *Carica papaya*. The articles published in Google Scholar indexed journals were primarily referred for writing this review.

Botanical Classification

Plant taxonomy is the science of discovering, identifying, describing, classifying, and naming plants. Linnaeus named the genus Carica after the leaves of these plants, which resemble those of the common fig *(Ficus carica).* The popular name is derived from the Taino word papáia, which was transformed in Spanish to papaya, the most widely used term in the globe, with minor modifications. The fruit is known as papaw or pawpaw in Australia and several Caribbean nations.[1]

Table 1: Taxonomy of Carica papaya[1]

Taxonomy of *Carica papaya*	
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Brassicales
Family	Caricaeae
Genus	Carica
Species	Papaya L.

Morphology

Papaya is a polygamous species that can grow up to a height of 10m in length. The leaves are broad and oval-shaped with a diameter of about 20-28 inches and are connected to thin branches which are grown one above another spirally. Male, female, and hermaphrodite Papaya plants are difficult to distinguish. A white discharge of latex appears when any section of the plant is incised.[1]

The flowers of *Carica papaya* are 5-parted light pale petals that are white and exist in two distinct forms, both the male and female flowers are fused along with the petals, wherein the female flower contains an ovary at the base and the petals are connected loosely at the base with each other.[2]

Figure 2: *Carica papaya* plant

The plant bears fruits on the axillary portion of the main stem in a single or group and the fruits are green until there are ripe and turn from yellowish orange to red upon ripening. Inside the ripened fruit, the central cavity is filled with seeds and the surrounding fleshy edible part is yellowish orange to pinkish. The maturity of the fruit depends on the temperature and the cultivation conditions. Usually, the plants start to bear fruits between 6-12 months and the fruits mature within 5-9 months.[1]

Figure 3: *Carica papaya* flowers

Distribution

Papaya is known to be originated emerged from Southern Mexico and Coast Rica, which was later bought into tropical and subtropical regions of the world including countries such as India, Srilanka, South Africa, and Australia as a farm crop. Papaya is cultivated in many regions of India such as Maharashtra, Bengal, Harayana, Delhi, and Andhra Pradesh commercially as a farm crop and as well as in gardens.[3]

Chemical constituents of *Carica papaya linn*.

Many pharmacologically active chemicals are found in papaya. Chymopapain and papain are two significant chemicals. Papain has a wide pH range of activity and is used to treat arthritis, dyspepsia, and other digestive problems, as well as to reduce swollen tonsils in liquid form. Human urine acidity is reduced by eating papaya. The Food and Drug Administration (FDA) recently approved chymopapain for intradiscal injection in individuals with herniated lumbar intervertebral discs.[4] The leaves, roots, fruit, and shoots contain different chemical constituents wherein the leaves of papaya constitute tannins, saponins, and alkaloids. The fruit of Papaya constitutes Ca, Fe, Mg, and the unripe fruit of Papaya contains papain and chymopapain. Along with the minerals, the fruit of Papaya contains carotenoids such as beta-carotene, cryptoxanthin, and linalool,monoterpenoids.[2]

Table 2: Phytoconstituents of C. papaya plant[1]

Part	Constituents
Fruits	Protein, fat, fibre, carbohydrates, minerals: calcium, phosphorous, iron, vitamin C, thiamine, riboflavin, niacin, and carotene, amino acids, citric and malic acids (green fruits), volatile compounds: linalool, benzylisothiocyanate, *cis* and *trans* 2, 6-dimethyl-3,6 epoxy-7 octen-2-ol, Alkaloid, α; carpaine, benzyl-β-D glucoside, 2-phenylethyl -β-D-glucoside, 4-hydroxy-phenyl-2 ethyl-β-D-glucoside and four isomeric malonated benzyl-β-D-glucosides.
Juice	N-butyric, n-hexanoic and n-octanoic acids, lipids; myristic, palmitic, stearic, linoleic, linolenic and *cis*-vaccenic and oleic acids.
Seed	Fatty acids, crude protein, crude fibre, papaya oil, Carpaine, benzylisothiocyanate, benzylglucosinolate, glucotropacolin, benzylthiourea, hentriacontane, β-sitosterol, caricin and an enzyme myrosin.
Root	Carposide and an enzyme myrosin.
Leaves	Alkaloids carpain, pseudocarpain and dehydrocarpaine I and II, choline, carposide, vitamin C and E.
Bark	β-Sitosterol, glucose, fructose, sucrose, galactose and xylitol.
Latex	Proteolytic enzymes, papain and chemopapain, glutamine cyclotransferase, chymopapains A, B and C, peptidase A and B and lysozymes.

Enzymes: bioactive moieties in papaya

Papaya contains a variety of physiologically active moieties. Papaya latex is known to contain strong lipase activity. It contains glycyl endopeptidase, cysteine proteinases, serine proteinase inhibitor, glutaminyl cyclase caricain, class II chitinase, papain, and chymopapain, among other cysteine endopeptidases.

Carica papaya lipase (CPL) is a protease enzyme that serves as a biocatalyst for several biological reactions like in the modification of fats and oils, esterification and inter-

esterification of alcohols and acids which are the substrates, and also in the asymmetric resolution of various non-steroidal anti-inflammatory drugs and non-natural amino acids. (Saeed, F. et.al., 2014). Papaya lipase, which is a hydrolase enzyme and is called "naturally immobilized biocatalyst" because the affinity to bind water-insoluble fraction of crude papain is high.[3]

Papaya protease is an enzyme that can be used as an anti-inflammatory agent, antitumoral, anti-helminthic, wound healing, gastroenterology, urology, and many more. Another thiol protease enzyme, Papin which is a non-specific enzyme plays a significant role in the process of digestion and pepsin dilapidation.[5]

Nutritional Value

Papaya is rich dense nutritional food as good for health, the amount of calories acquired by consuming Papaya is way more than that from other fruits, the nutrients obtained from Papaya coincide with that the medicinal values obtained from it. The major portion of Papaya constitutes carbohydrates and specially invert easily digestible sugars. Apart from carbohydrates, it also contains proteins and negligible amounts of fats and cholesterol. The ripened fruit of Papaya when consumed can escalate high energy in our body.[4]

Table 3: The nutrient value of papaya

	Nutrient Value	RDA/Day for Indians
Energy	43 Kcal	2730 Kcal
Water	88.06 g	
Carbohydrates	10.82 g	
Protein	0.47 g	60 g
Total Fat	0.26 g	
Cholesterol	0 mg	
Dietary Fiber	1.7 g	
Vitamins		
Folates	37 µg	200 µg
Niacin	0.357 mg	18 mg
Pyridoxine	0.038 mg	2.0 mg
Riboflavin	0.027 mg	1.6 mg
Thiamin	0.023mg	1.4 mg
Vitamins A	285 µg	600 µg
Vitamins C	60.9 mg	40 mg
Vitamins E	0.30 mg	7.5-10 mg
Vitamins K	2.6 µg	55 µg

Reference: The nutrient value of Carica papaya followed from USDA National Nutrient Database and recommended Daily Allowance (RDA) referred from 'Nutrient Requirement and recommended

Papaya carries high nutritive content and contains greater amounts of carotene, and low calories (32 kcal/100 g of ripe fruit), which makes it a desirable food for the people who want to reduce their weight and those who are obese.[5] Papaya contains high amounts of vitamin A and C, which are helpful for the improvement of eyesight, and also the unripe papaya is utilized in the preparation of fruit juices, and salads, and is also a delicacy.[3] The fruit pulp of Papaya when applied to the skin makes the skin soft and helps in getting rid of chemicals. The milky juices obtained from papaya which is not yet ripened are utilized in the preparation of facial creams.[6]

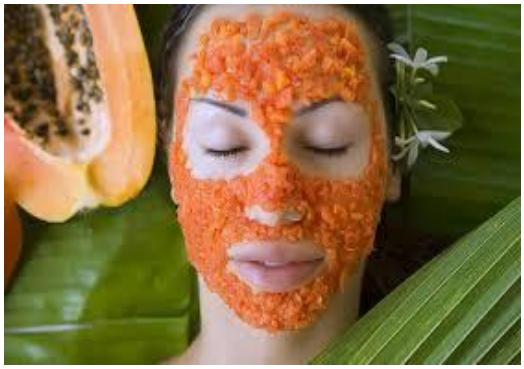

Figure 4: *C.* papaya pulp face mask

The fruit comprises several vitamins, minerals, flavonoids, saponins, and more, The Papaya fruit can be utilized to hinder the problems related to Diabetic Mellitus and the fermented Papaya fruit acts as a nutrient food as it is rich in antioxidants. The seeds of Papaya are black, which is edible, and are spicy to taste when consumed.[3]

Papaya roots demonstrate abortifacient action and act as a generative toxin to cure piles; they also show antibacterial and antifungal activity and purgative effect. Fresh roots are administered orally with sugarcane alcohol for alleviating rheumatism.

Figure 5: *Carica papaya* roots

Pharmacological profile of *Carica papaya*

Anticancer Property

Anticancer activities have been demonstrated by papaya extracts in several *in vitro* studies. Papaya juice and pure lycopene, a component present in papaya, caused cell death in the liver cancer cell line, Hep G2, with the half-maximal inhibitory concentration (IC 50) of 20 µg/mL and 22.8 µg/mL, respectively. In acute promyelocytic leukemia HL-60 cells, papaya seed extract had anticancer action at an IC 50 of 20 g/mL, but papaya pulp extract had no impact even at a concentration of 100 g/mL.

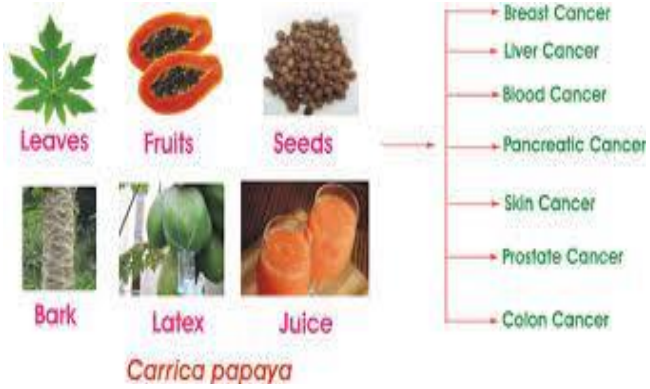

Figure 6: Anticancer activity exhibited by various papaya parts

Several research studies have revealed the activity of aqueous extract of seeds of Papaya on human colon epithelial cells, human lung fibroblasts, human pancreatic cells, and human kidney epithelial cells. It was interesting that upon consumption of papaya leaf extract was effective in the patients suffering from stomach cancer, breast cancer, pancreatic cancer, liver cancer, blood cancer, and lung cancer even though human clinical trials are yet to be performed. The methanolic extract obtained from the black seeds of Papaya is remarkably successful in inhibiting the cell proliferation of prostate cancer cells. On the other hand, the methanolic extract obtained from the white seeds of Papaya is not effective as that of the black seeds.[7]

Anti-cancer potential of hexane fraction from the male flower of *Carica papaya* was evaluated by performing a 3-(4,5-dimethythiazol-. 2-yl)-2,5- diphenyl tetrazolium bromide MTT test on WiDr cells i.e., colon cancer cells were performed and it was observed that the hexane fraction showed significant inhibition on the cell viability and this might be due to the presence of triterpenoids and steroids present in the fraction, suggesting its use as a chemosuppressive agent and with cytotoxic properties.[8]

Di-methyl flubendazole which is a biologically active molecule isolated from the extracts of *Carica papaya* leaves was made into silver nanoparticles (AgNPs) and investigated for its anti-cancer activity, wherein it was observed that the antiproliferative effect on different cancer cell lines such as A549, HepG2, MCF-7 that there was time-dependent antiproliferative effect with significant inhibition. AgNPs-treated cells sowed significant necrosis, cell shrinkage, membrane blebbing, and cell decay. These results suggest that di-methyl flubendazole-based silver nanoparticles can be an effective way as antitumor agents.[9]

Benzyl glucosinate is produced in the pulp of papaya and its hydrolyzed product benzyl isothiocyanate (BITC), a compound known for its anti-cancer and cancer-preventive activity. BITC activity against human lung cancer H69cells was evaluated using an MTT assay and it was observed that BITC had remarkable anti-proliferative activity when administered with higher concentration.[10]

The ethanolic extract and water extract of *C. papaya* were investigated on pancreatic cancer cells derived from primary (MiaPaCa-2) and metastatic (ASPC-1) sites, wherein it was observed that the ethanolic extract reduced cell viability of MiaPaCa-2 and ASPC-1 pancreatic cancer cells. The ethanol extract showed the same cytotoxic effect same as gemcitabine towards MiaPaCa-2 and a remarkably greater cytotoxic effect than gemcitabine against ASPC-1 cells.[11]

To evaluate the effect of papaya leaf extracts on SCC20 and HaCaT cells, cell viability was analyzed and it was observed that two fractions with acidic pH showed remarkable selective cytotoxicity towards SCC20 cells and were found to contain high levels of phenolic and flavonoids glucosides, suggesting anticancer activities.[12]

Anti Dengue Property

Dengue is a mosquito-borne viral disease caused by the Dengue virus, which is spread due to a mosquito named *Aedes egypti*. A healthy person can get affected within 5-7 days of a mosquito bite, and the symptoms usually include high fever, headaches, rash, eye pain, and vomiting.[13] *Carica papaya* may have an anti-dengue impact by addressing the thrombocytopenia associated with the disease. In vitro investigations of *C. papaya L.* leaf extracts revealed membrane stabilizing effects. The researchers discovered that *C. papaya L.* leaf extracts reduced heat- and hypotonicity-induced hemolysis in erythrocytes from both healthy and dengue-infected people; the effect was shown at lower doses of the extracts. As a result, the extracts are expected to have membrane-stabilizing effects and protect blood cells from stress-induced cell death. This feature might be beneficial in people with dengue fever, where the extracts from the leaf can inhibit the lysis of platelets due to the existence of phenolic compounds and flavonoids in them.[14]

In vitro study was performed on *C. papaya* against DENV2 and it was observed that the chloroform and methanol extract have no direct role against DENV2 but there was an elevation in the red blood cell count, white blood cell, platelets, and other immune cells with anti-oxidant and immune-stimulating phytochemicals that stimulate immune cells to decrease dengue viral symptoms, suggesting that crude chloroform extract had moderate or less inhibitory effect DENV2.[15]

The anti-dengue activity of *C. papaya* aqueous leaf extract was evaluated wherein it was noticed that papaya leaf exhibited a cytotoxic effect. To understand the antiviral effect of papaya leaf extract western blotting was performed, wherein it was observed that there was a reduction in more than four-fold envelope protein expression and the same with NSI protein expression. Papaya leaf extract caused a reduction in the mean fluorescence intensity noting the reduction in the intracellular viral load. Papaya leaf extract did not show any hemolytic activity at various doses. The anti-hemolytic activity was remarkably greater in the Papaya leaf extract-treated group when compared to ascorbic acid which is a positive control. It was also observed that there was a reduction in the erythrocyte damage and hydrogen-peroxide-induced lipid peroxidation, with elevated levels in the platelet number and IL-6 and thrombopoietin levels.[16]

Anti-inflammatory and immunomodulatory properties

Carica papaya is rich in secondary metabolites which are biologically useful such as alkaloids, phenolics, flavonoids, etc., and proteolytic enzymes such as chymopapain and papain. These abundant phytochemicals are which are found in abundance are minimize chronic inflammation and its related side effects by changing the levels of inflammatory markers.

Apart from the secondary metabolites, Papaya also contains proteolytic enzymes such as papain and chymopapain which are known for their anti-inflammatory and immunomodulatory agents. The excessive production or the activation of transforming growth factor (TGF)-β in the process of inflammation is known, the usage of papain with other enzymes namely trypsin and chymotrypsin has remarkably decreased TGF-β1 in the patients who were suffering from rheumatoid arthritis, osteomyelofibrosis, herpes zoster. Apart from this, it was also known to decrease the inflammatory side effects due to radiotherapy in neck and head cancer patients. Transcription factors, cytokines, and antioxidant enzyme levels are regulated by secondary metabolic compounds belonging to the classes of carotenoids, phenolics, and glucosinolates.[17]

Xylene-induced ear edema and carrageenan paw edema tests were performed to evaluate the anti-inflammatory effect of *Carica papaya* and in the xylene-induced ear edema test, it was observed that papaya showed a minimal effect and no remarkable effect in carrageenan paw edema test.[18]

Leukotrienes acts as initiators of inflammation and lipoxygenase (LOXs) catalyze its biosynthesis, it was observed that the methanol extracts of *Carica papaya* showed significant inhibitory activity against LOXs activity.[19]

The anti-inflammatory activity of ethanolic extract of *Carica papaya* leaves was evaluated. The results obtained from the carrageenan edema test show that there was a remarkable and dose-dependent decrease in the paw size when compared to control and drug-induced groups. The results from the granuloma test show that there was a remarkable decrease in the amount of granuloma formed in the treatment group. Formaldehyde-induced arthritis tests show that *Carica papaya* caused a decrease in inflammation in arthritis rats when compared to drug-induced and control groups.[20]

Methanolic extract of seeds of *Carica papaya* was investigated, wherein it was observed that there was remarkable inhibition of edema at various concentrations in the dose and time-dependent manner.[21]

Antimalarial property

Research studies have proven the idea of the anti-malarial activity of *Carica papaya*. The methanolic extract *Carica papaya* was evaluated for its anti-malarial effect in mice on Plasmodium bergheiNK65 strain. Another study was done on the leaf extract of *Carica papaya* and was evaluated against Plasmodium falciparum 3D7 and Dd2 strains. Apart from these, methanol, chloroform, and petroleum ether extract of roots of papaya, fruit rind was evaluated against Plasmodium berghei in mice, it was found that petroleum ether extract has greater anti-malarial activity and it also petroleum ether and chloroform extract of *Carica papaya* fruit rind has shown remarkable anti-plasmodial activity in a dose-dependent manner.[2]

Vernonia amygdlina and *Carica papaya* are in combination to understand their effect on *Plasmodium berghei*, it was observed that aqueous leaf extracts of *V. amygdalina* and *C. papaya* showed significant antimalarial activity but it was remarkably higher in the group treated with *C. papaya* alone with elevated levels of RBC and PCV recovery with exception to WBC. The histological sections of mice treated infected with *P. berghei* and treated with *V. amygdalina* and *C. papaya*, wherein it was noticed that when used in combination there was a minor restoration of the diffused proliferated hepatic cells causing hepatic cells to recover from congested black pigmentation.[22]

Petroleum ether fraction of *C. papaya* fruit rind was evaluated against *P. berghei* and it was found that *C. papaya* showed a dose-dependent chemo suppressive antiplasmodial activity *in vivo*. The petroleum ether fraction from *C. papaya* root along with ether and chloroform fractions showed greater parasitic suppression activity in different concentrations.[23]

In vitro antioxidant assay of *C. papaya* showed that the extract showed greater antioxidant activity when compared with that of the reference compound. A four-day chemosuppressive test was performed to investigate the ability of the extract to prevent the establishment of the infection, and it was observed that extracts of *C. papaya* caused a reduction in the parasitemia, elevated mean survival time, weight, and packed cell volume in a concentration does-dependent manner. The curative test results showed that there was suppression in the parasitemia level with a reduction in the hepatotoxic levels, neuropathy, oxidative stress, lipid peroxidation, and dyslipidemia. The results put together shows that extract of *C. papaya* possesses antimalarial properties and can reduce metabolic dysregulation caused by Plasmodium berghei infection.[24]

The ethanolic leaf extract of *C. papaya* against *Plasmodium falciparum (P. falciparum)* was investigated and it was observed that larvicidal and pupicidal activity at different various concentrations elevated with an increase in the concentration against malarial vector, *A. stephensi.* Various concentrations of ethanolic lead extract of *C. papaya* against *Plasmodium falciparum* showed a remarkable inhibitory effect. These results suggest that ethanolic extract of *C. papaya* can be used to control vector mosquitoes.[25]

Antioxidant Property

Different plants were extensively studied for their oxidative properties and have been consumed for the treatment of several diseases worldwide. *Carica papaya* seeds are evaluated using antioxidant assay methods such as DPPH assay, ABTS, NO_2, and ferric ion reducing power method to know the abundant quantities of bioactive secondary metabolites. A research study on *Carica papaya* by using

free radical-scavenging activity revealed that it exhibited significant antioxidant activity when compared to the standard ascorbic acid.[26]

The total phenolic content of the seed extract with a stable free radical provides us with information that, *C. papaya* shows a strong absorption band, with remarkable inhibition as that of Gallic acid.[19]

Anti-oxidant activity using α,α-diphenyl-β- picrylhydrazyl (DPPH) Analysis was performed on the hexane fractions from the male flower of *C. papaya*, and it was observed that hexane fractions showed significant antioxidant activity.[8]

Antidiabetic Property

The research found that the aqueous extract of *C. papaya* had a hypoglycemic and antioxidant impact on diabetic rats, as well as an improvement in their lipid profile. The impact of *Carica papaya* leaf extract on streptozocin-induced diabetes in rats was investigated in this study. Furthermore, the leaf extract had a favorable impact on the liver and pancreas integrity and function. It's thought that the aqueous *C. papaya* leaf extract works by stimulating the few remaining β- cells, causing more insulin to be released. There are no human studies on the usage of papaya leaves in this way.[27]

Intestinal mucosa and pancreas saliva is found to contain alpha-amylase which is a digestive enzyme and is responsible for breaking on glycosidic bonds present in the starch making the availability of glucose in the blood, wherein it was observed that when methanolic extract of *C. papaya* leaf was given at different concentrations, there was a dose-dependent elevation in the percentage inhibitory activity against the alpha-amylase enzyme, thus causing its blockage. In vitro screening method for hypoglycemic effect on Yeast cell was performed to the effect of methanolic extract of *C. papaya*, wherein it was observed that when administered it caused an increase in the glucose uptake by yeast, thereby controlling the blood glucose levels. *C. papaya* caused a reduction in the formation of glucose hemoglobin thus inhibiting the production of the reactive oxygen species.[27]

Diabetes-induced mice were treated with different concentrations of ethanolic extract of *C. papaya* and it was observed that it normalized the bodyweight which was seen in diabetic mice. Ethanolic leaves extract of *C. papaya* caused a remarkable reduction in the serum glucose levels in the blood. In Diabetic mice, the serum triglycerides and cholesterol levels were elevated and decreased high-density lipoprotein which returned to normal levels after administration of *C. papaya*. The levels of liver enzymes such as ALT, AST, ALP, and total bilirubin were remarkably elevated upon treatment with *C. papaya*.[29]

In vitro anti-diabetic activity was performed on seed extracts of *C. papaya*, and it was observed that the ethyl acetate fraction designated as D showed remarkable activity in pancreatic α-amylase and α -glucosidase when compared to that of other fractions. The ethyl acetate fraction which showed maximum inhibition was further purified and sub-fractions were made it was observed that all the sub-fractions made showed maximum inhibition activity against α-amylase with sub-fraction K being more than them. In the case of α –glucosidase, all the sub-fractions showed a maximum inhibitory response in a concentration-dependent manner with sub-fraction K being the highest.[26]

Ethanolic extract of *C. papaya* leaves was evaluated for its anti-diabetic activity and it was observed that upon administration of different concentrations of extracts of *C. papaya*, there was a remarkable decrease in the fasting blood sugar levels suggesting that it has an antihyperglycemic effect and was also noticed that the higher concentration of *C. papaya* showed the similar result as that of the standard drug glibenclamide. The total cholesterol and triglycerides concentrations were remarkably reduced upon administration on various doses of *C. papaya*, suggesting its usage in preventing Coronary heart disease. The levels of very-low-density lipoprotein-cholesterol and High-density lipoprotein levels were reduced and elevated upon administration of *C. papaya*. These results put together suggest that *C. papaya* leaves extract can act as an anti-diabetic agent.[28]

Orally administered *C. papaya* leaf extract was investigated against Streptozocin diabetic rats, wherein it was observed that the treatment with *C. papaya* caused a reduction in the liver and pancreatic weight to normal but did not show any effect on kidney and heart weight. Fasting blood sugar levels were reduced remarkably which was indistinguishable from the control group but remarkably lowered in the diabetic group. The low-density lipoprotein cholesterol levels of *C. papaya* were remarkably reduced when compared to the untreated group. Whereas the serum High-density lipoprotein cholesterol was elevated when compared to that of the diabetic control. The coronary risk index of the treatment group was reduced when compared to that of the untreated group.[30]

Anthelmintic and Anti-Amoebic Properties

Seeds of *Carica papaya* are used in the treatment of helminthiasis. The fruits, latex, and seeds of papaya contain an anthelmintic alkaloid named carpaine which is responsible to remove the worms from the body and when consumed in high doses can be fatal too. The aqueous extracts and latex of papaya are known to exhibit anthelmintic and anti-amoebic activity. Apart from these, benzyl isothiocyanate and papain present in the seeds of *Carica papaya* are evaluated and identified for their anthelmintic properties. Papaya seeds that are air-dried are cost-effective, safe, and possess an inhibitory effect against intestinal parasitosis majorly in people dwelling in tropical regions.[4]

C. papaya latex was used against *Heligmosomoides polygyrus* to evaluate its anti-helminthic activity wherein it was observed that papaya latex showed anti-parasitic activity at different concentrations against *Heligmosomoides polygyrus*, thus proving its anti-helminthic activity.[31]

Anthelmintic efficacy of aqueous and crude extract of *C. papaya* was investigated using various parameters. The experimental animals and birds were highly infested with Heterakis gallinarium, Trichostrogylus tenius to Ascaridia *galli.* The drug and powder, aqueous extracts when

administered showed a remarkable reduction in the fecal egg count showing significant deworming. Hematological report after that treatment with *C. papaya* showed that the packed cell volume, means of hemoglobin, red blood cells, and lymphocytes were remarkably elevated with the reduction in the eosinophils values.[32]

C. papaya latex was investigated against worm burden in poultry. After artificial helminth infection for 16 weeks, oven-dried ground latex was administered and it was observed that fecal analysis for the egg count resulted that there was a decrease in the Egg per gram in the treatment group indicating that it can be used as anthelmintic.[33]

Anthelmintic activity of *C. papaya* extract against *Ancylostoma caninum* was evaluated, wherein it was observed that there was an elevation in the mucosal mast cells, reduction in the larvae, and eosinophils levels, suggesting *C. papaya* activity in intestinal nematodes.[34]

Latex of *C. papaya* was evaluated against *Pheretima posthuma*, wherein it was observed that different concentrations caused paralysis and death of worms, it was significant at higher concentrations when compared to standard reference and control.[35]

Conclusion

According to the findings, phytoconstituents obtained from C. papaya are the greatest alternative for fighting illnesses. This is one of the most versatile plants which has been used for medicinal as well as household purposes. All parts of plants had been used in the prevention and treatment of various diseases. Extracts from the plant's many sections are still employed in herbal medicine to treat chronic and acute ailments, viral pathogens, and immune modulators. Due attention should be paid to its nutraceutical, functional, and medicinal asserts; its food therapy for the prevention and cure of various maladies and disorders. To investigate the effect of papaya in the prevention of various malignancies, cardiovascular illnesses, age-related macular degeneration, and gastrointestinal disorders, comprehensive investigations and well-designed randomised clinical trials are necessary.

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