Review Article **CODEN: AJPCFF** **ISSN: 2321 – 0915**

Asian Journal of Phytomedicine and Clinical Research

Journal home page: www.ajpcrjournal.com

CHEMICAL INGREDIENTS AND PHARMACOLOGICAL PROPERTIES OF *CARICA PAPAYA:* A REVIEW

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ABSTRACT

Papaya is often proverbial for its food and nutritionary values throughout the globe. The properties of papaya fruit and other parts of the plant are also well known in traditional system of medicine. During the previous few decades tidy progress has been achieved concerning the biological activity and healthful application of papaya and currently it's thought-about as valuable nutraceutical fruit plant. Carica papaya is employed in ayurvedic medicines from terribly very long time. It is used as medication, antioxidant, diuretic, antibacterial, abortifacient, vermifuge, hypoglycemic, antifungal activity, antihelmenthic and immunomodulatory etc. Scientific evidences counsel their versatile biological perform that supports its ancient use in numerous diseases. Phytochemical studies shows that plant fruit tree contains in the main alkaloids carpaine, pseudocarpaine, tannins, flavnoids, carcin, gamma terpine, organic compound carposides, sugars etc. The plant has effective pharmacological activity such as anti-inflammatory, antioxidant, diuretic, antibacterial, abortifacient, hypoglycemic, antifungal, antihelmenthic and immunomodulatory, hepatoprotective and anticonvulsant activity.

KEYWORDS

Carica papaya, Caricaceae, Chemical Constituent and Medicinal properties.

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INTRODUCTION

Medicinal sources square measure simply and copiously accessible in nature since past times, flavorer supply of active ingredients helps in managing refractory diseases, for this reason trade of plant materials are multiplied[1]. Herbs square measure gaining their position high because the artificial medicine square measure unsafe and not sensible to setting, herbs square measure safe and

secured to use and have qualities like aromatic, flavorer and medicative properties. Hence, flavorer renaissance is occurring everywhere the world[2]. All plant components have medicative values however the active elements concentration varies from structure to structure[3]. These medicative values dwell some chemical substances that alter physiological modification within the body[4].

Cultivation and outline

Formerly from southern North American nation (particularly Chiapas and Veracruz), Central America, and northern South America, the papaya is currently cultivated in most tropical countries. In cultivation, it grows chop-chop, mature at intervals 3 years. It is, however, extremely frost-sensitive, limiting its production to tropical climates. Temperatures below 29° Gabriel Daniel Fahrenheit square measure greatly harmful if not fatal. In Florida, growth is usually restricted to southern components of the state. It conjointly prefers sandy, well-drained soil as standing water can kill the plant at intervals twenty four hours[5]. The papaya incorporates a moderately difficult means that of replica. The plants square measure male, hermaphrodite, or feminine[6]. The male trees square measure uncommon, however typically occur once owners collect their own seeds. Hermaphrodite trees square measure the business customary, manufacturing a pear formed fruit. These plants square measure self pollinated[7]. Papaya exhibits sturdy top dominance seldom branching unless the top plant tissue is removed, or damaged. Palmately-lobed leaves, typically massive, square measure organized spirally and clustered at the crown, though some variations within the structure and arrangement of leaves are reportable with Malaysian cultivars[8]. Generally, papaya cultivars square measure differentiated by the quantity of leaf main veins, the quantity of lobes at the leaf margins, leaf shape, stomata sort, and wax structures on the leaf surface, additionally because the color of the leaf stem. Papaya fruits square measure borne by each feminine and hermaphrodite trees, however their shapes disagree. Fruits from feminine trees square measure spherical whereas fruits from hermaphrodite trees square measure elongated. The fruit could be a berry that may vary from five cm in diameter and fifty g in weight to fifty cm or longer, advisement ten kilogram or additional[9]. Papaya fruits square measure coated with a swish skinny inexperienced skin that turns to yellow or red once ripe. The flesh is succulent, variable in texture and color starting from yellow to orange to red.

Morphology

Papaya may be a polygamous species and it's troublesome to spot a plant whether or not it's male, feminine or hermaphrodite. It is a tree reaching 3-10 m in height, with the habit of a palm; the fleshy stem marked by scars where leaves have fallen off, is surmounted by a terminal panache of leaves on long petioles and with 5-7 lobes. Flowers scented, trimorphous, usually unisexual-dioecious, male flowers in lax many-flowered, densely pubescent cymes at the tips of the pendulous, fistular rachis; female flowers large, solitary or in few flowered racemes, with a brief thick rachis, fruit a large berry, varying widely in size, elongate to globose with a large central cavity, seeds black, tuberculous and enclosed in a transparent aril. The fruit bearing trees are less than 18 month old. The leaves and unripe fruit contain milky juice in which the protein ferment papain is present. The papaya is a large tree-like plant, with a single stem growing with spirally arranged leaves confined to the top of the trunk. The lower trunk is prominently scarred wherever leaves and fruit were borne. The leaves ar giant, 50-70 centimeters (20-28 in) diameter. The tree is usually unbranched, unless lopped. The flowers are similar in form to the flowers of the magnoliopsid genus, but are much smaller and wax-like. They appear on the axils of the leaves, maturing into the large 15-45 centimeters (5.9-18 in) long, 10-30 centimeters (3.9-12 in) diameter fruit. The fruit is ripe when it feels soft (like a ripe avocado or a bit softer) and its skin has attained amber to orange hue. The melon-like fruit varies in size and form, and hangs from short, thick peduncles at the leaf axil. Its flowers are mostly dioecious and resemble each other until they start to

develop sexual organs. The species is polygamous and can be classified into three sex types: male staminate, hermaphroditic (bisexual) and female pistillate. In addition, some plants will turn out over one reasonably flowers[10].

The pollination mechanism of the plant is not very well known but researchers 'Baker' and `Bawa' suggested that "pollination is performed by mimicry of the pistillate flowers to the staminate nectar-producing flowers." Another theory is that oxyalate packages within the ANthers of the papaya play a job in fecundation as an enrichment of the nectar. Whatever the case, we do know that the fruit is of great economic importance to tropical America where it is widely grown for its luscious fruit. The fruit that is orange-yellow once ripen, is a popular breakfast staple that is also used in jellies, preserves, fruit juices and as a beverage in certain Latin countries. In addition, the leaves and root of the plant are also used in a variety of dishes. The bark may be used for rope creating and also the leaves as a soap substitute, is an excellent stain remover. Finally, in Java, even the flowers square measure ingested[10].

Chemical 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, benzyl isothiocyanate, 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[10,11].

Juice

N-butyric acid, n-hexanoic acid and n-octanoic acids, lipids; myristic, palmitic, stearic, linoleic, linolenic and cis-vaccenic and oleic acids[11].

Seed

Fatty acids, crude supermolecule, crude fibre, papaya oil, sinigrin, Carpaine, benzylisothiocyanate, chemical group glucosinolate, glucotropacolin, benzylthiourea, hentriacontane, β-sitosterol, caricin ANd an protein myrosin, leaves connected alkaloids, flavonoids, saponins, tannins, steroid, anthraquinones and cardinolodes are present[11].

Root

Carposide and 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[11].

Nutrient contents of the papaya

Papaya is a major fruit crop worldwide that is primarily consumed as fresh fruit. Papaya fruits consist mostly of water and carbohydrate, low in calories and rich in natural vitamins and minerals, particularly in vitamins A and C, ascorbic acid and potassium[12]. A green papaya fruit has been reported for its nutrient content, which (per 100g) provides 26 calories, 92.1 g H2O, 1.0g protein, 0.1g fat, 6.2g total carbohydrate, 0.9g fiber and 0.6g ash. USFDA National Nutrient database recorded an orange-freshed papaya (per 100g) contained 39 calories, 88.8g H2O, 0.61g protein, 0.14g fat, 9.81g total carbohydrate, 1.8g fiber, 0.61 g ash[13]. Oyoyede tested the chemical profile of unripe pulp of *carica papaya* and reported papaya fruit was very rich in carbohydrate (42.28% starch, 15.15% sugar) but low levels of fat[14]. Papaya fruit also contains high levels of vitamin C (51.2 mg/100g), Vitamin A precursors including β-carotene (232.3 μg/100g), and β-cryptoxanthin (594.3 μg/100g), as well as magnesium (19.2-32.7 mg/100g), which has been reported by Wall[15]. The papaya seeds contain balance-nutrients which consist of protein (24.3%), fatty oil (25.3%) and total carbohydrate (32.5%). Although it contains significantly high level of unsaturated fatty acids, papaya seeds seem not to be good oil seeds. In some tropical countries, papaya

leaves are used as food sources, which can be cooked by stir fry. The papaya leaves (per 100g), were reported by Duke, contains 74 calories, 77.5g H2O, 7.0g. protein, 2.0g fat, 11.3 g total carbohydrate, 1. 8g fiber, 2.2g ash, 344mg Ca, 142mg P, 0.8 mg Fe, 16mg Na, 652mg K, 11,565ug β-carotene equivalent, 0.09mg thiamine, 0.48 mg riboflavin, 2.1 mg niacin, and 140 mg ascorbic acid, as well 136 mg Vitamin E[13].

Medicinal Uses of Different Parts[16-18]

Latex

It is used as Anthelmintic, relieves dyspepsia, cure diarrhoea, pain of burns and topical use, bleeding haemorrhoids, stomachic, whooping cough.

Fruits

Ripe fruits can be used as stomachic, digestive, carminative, diuretic, dysentery and chronic diarrhea, expectorant, sedative and tonic relieves obesity, bleeding piles, wounds of the urinary tract, ringworm and skin disease psoriasis. Unripe fruits are used as drug, laxative, dried fruit reduces enlarge spleen and liver, used in snake bite to remove poison, abortificient and anti implantation activity, anti bacterial activity.

Seeds

Carminative, emmenagogue, vermifuge, abortificient, counterirritant, as paste in ringworm disease, psoriasis, antifertility agent in males.

Seed juice

Bleeding piles and in large liver and spleen.

Root

Abortificient, diuretic, is checking irregular bleeding from uterus and anti fungal activity, piles.

Leaves

Young leaves used as vegetables, jaundice, urinary complains, urinary tract infection and gonorrhea, dressing wounds, anti bacterial activity, vermifuge in colic, fever, beriberi, abortion, asthma.

Flowers

Emmengogue, jaundice, febrifuge and pectoral properties.

Stem bark

Jaundice, antifungal activity, antihelmantic activity.

General uses

Papaya can be used as a diuretic (the roots and leaves), anthelmintic (the Leave and seed) and to treat bilious conditions (the fruit). Parts of the plant are wont to combat upset {stomach|symptom} and different organic process disorders (papaya contains a protease that soothes the stomach and aides in digestion) and a liquid portion has been used to reduce enlarged tonsils. The juice is employed for warts, cancers, tumors, corns and skin defects while the root is said to help tumors of the uterus. In Africa a root infusion is also used for syphilis and the leaf is smoked to relieve asthma attacks. The Javanese believes that uptake papaya prevents rheumatism and in Cuba the latex is employed for skin condition, ringworm and the removal of cancerous growth.

Medicinal properties

Many biologically active substances have been isolated from papaya and studied for their pharmacological action. An antifungal chitinase has been sequence cloned and characterised from papaya fruit. The chitinase category fied| is assessed| is classed} as class IV chitinase supported its aminoalkanoic acid sequence similarity with different plant chitinases. The recombinant papaya chitinase also has antibacterial activity[19]. The purified chemopapain from commercially available spray dried latex of the fruits has shown immunological properties[20]. The anthelmintic activity of papaya seed has been variously ascribed to carpaine (an alkaloid) and carpasemine (later identified as benzyl thiourea) and benzylisothiocyanate[21], cysteine proteinases from papaya fruit have also been reported[22]. Carpaine, an alkaloid with an intensively bitter taste and a strong depressant action on the heart, has been obtained from the fruit and seed, but especially from the leaves. Biological activities of papaya are reported with the crude extracts and totally different fractions from latex, seed, leaf, root, stem bark and fruit. However, crude extracts of various elements of papaya are used as ancient medication for the treatment of varied diseases. However, apart from these, there are several reports on the therapeutic

properties and pharmacological actions of papaya based on modern scientific investigations. Some have been discussed below.

Antifungal

The latex of papaya and Fluconazole has synergistic action on the inhibition of *Candida albicans* growth. This synergistic effect results in partial cell wall degradation (as indicated by transmission electron microscopy observations)[23]. Latex alone is statically effective on C. albicans once supplementary to a culture throughout the exponential growth part and some hour was achieved. This fungistatic result is that the results of semipermeable membrane degradation because of a scarcity of polysaccharides constituents within the outer layers of the fungous semipermeable membrane and unleash of cell debris into the culture medium[24].

Antimalarial Activity

The petroleum ether extract of the rind of raw papaya fruit exhibits significant antimalarial activity. There could also be important business potential in extracting the active component from this plant, which grows abundantly throughout the tropics and the rind of which is discarded as waste, can be exploited for antimalarial activity[25].

Antihelmenthic activity

The latex of papaya has anthelmintic efficacy against *Heligmosomoides polygyrus* in experimentally infected mice, which suggests its potential role as an anthelmintic against potent intestinal nematodes of mammalian hosts[26]. It also has anthelmintic activity against natural infection of *Ascaris suum* in pigs and found to be 100% effective at the dose of 8g/kg body weight[27]. The plant extracts of papaya possesses a dose dependent significant effect on the egg, infective larvae and adult worms of *Trichostrongylus colubriformis*[28]. Alcoholic extracts of papaya shows potential in vitro anti-parasitic action, which affects eggs, infective larvae and adult *Haemonchus contortus*[29].

Antimicrobial activity

The seed of papaya has antimicrobial activity against *Trichomonas vaginalis* trophozoites. The report suggests the use of papaya seed in urinogenital disorder like trichomoniasis with care to avoid toxicity[30]. The seed and pulp of papaya was shown to be organic process against many enteropathogens like *Bacilli, Enterobacter cloacae, Escherichia coli, Salmonella typhi, Staphylococcus aureus, Proteus vulgaris, Pseudomonas aeruginosa* and *Klebsiella pneumoniae* by the agar cup plate method[31]. Purified extracts from ripe and unripe fruits conjointly produces terribly important bactericide activity on *S. aureus, Bacillus cereus, E. coli, P. aeruginosa* and *Shigella flexneri*[32].

Anti-amoebic activity

The cold macerated aqueous extract of matured papaya seeds has shown anti-amoebic activity against *Entamoeba histolytica*[33].

Male antifertility

Seed extract showed pronounced hypertrophy and dysplasia of pituitary gonadotrophs. Whereas the male rats treated with seed extract revealed gradual degeneration of Germ, Sertoli and Leydig cells as well as germinal epithelium, which confirmed its antifertility activity[34]. Aqueous extract of papaya seeds, 3 weeks after commencement of administration showed that the lumina of the somniferous tubules were more prominent and empty in the experimental animals with no evidence of spermatids and spermatozoa[35].

Diuretic

Aqueous root extract of papaya once given orally at a dose of ten mg/kg to rats produces vital increase in body waste output and shows similar profiles of urinary solution excretion to that of Hydrochlorothiazide[36].

Female antifertility

Sharma and Mahanta have reportable that the composite root extract containing papaya root extract in concert of the constituent, induces morphological changes in the endometrial surface epithelium in albino rat uterus. The characteristic smooth regular pattern of normal epithelium appears to have changed at places by haphazardly oriented groups of cells and loss of microvilli indicating a disorganized picture[37]. Whereas seeds binary compound extract has shown abortifacient properties on feminine Sprague Dawley rats[38] and

therefore the rock oil ether, alcoholic and aqueous extracts inhibits ovulation in rabbits[39].

Immunomodulatory activity

Fermented papaya preparation exerts both immunomodulatory and antioxidant activity in the macrophage cell line RAW 264 and it is a macrophage activator, which augments nitric oxide synthesis and TNF-alpha secretion independently of lipopolysaccharides[40]. The inhibitor cocktail derived from fermentation of unpolished rice, papaya and sea weeds with effective microorganisms of lactic acid bacteria, yeast and photosynthetic bacteria has shown inhibition of lipid peroxidation *in vivo*, a point dependent on the concentrations of bioactive flavonoids[41].

Nephroprotective activity

Maximum nephroprotection was offered by the extract at four hundred mg/kg/day CPE that lasted up to three hours post-CCl4 exposure and these organic chemistry evidences were supported by enhancements within the excretory organ histological lesions induced by CCl4 intoxication. Studies showed that CPE has nephroprotective effect on CCl4 renal injured rats, an effect which could be mediated by any of the phyto components present in it via either antioxidant and/or free radical scavenging mechanisms. Carica papaya plant has the nephroprotective activity[42].

Antisickling activity

The antisickling properties of fermented dried unripe fruit pulp of Carica papaya have been reported. The extract got from the materials incubated for five days indicated as SP5, was found to have the highest antisickling properties with 93% inhibitory and 84% reversal activities. The concentration of the day five extract was any varied. 0.2 milliliter was found to be the optimum volume of the take a look at extracts[43].

Anti-tumor activity

Aqueous extract of melon tree leaves exhibits anti-tumor activity and it's been reportable. In PBMC, the production of IL-2 and IL-4 was reduced following the addition of *Carica papaya* extract, whereas that of IL-12p40, IL-12p70, IFN-γ and TNF-α was enhanced without growth inhibition[44].

Treatment of Dengue fever with *Carica papaya* leaves extracts

Dengue viruses, mosquito-borne members of the arbovirus family, are the contributing agents of dengue[45]. Unwellness} is that the most significant rising infective agent disease of humans that in recent decades has become a significant international public health concern. Dandy fever is found in tropical and sub-tropical regions round the world, preponderantly in urban and semi-urban space[46]. It's calculable that there are between fifty and a hundred million cases of dengue (DF) and concerning five hundred 000 cases of dandy fever viral infection (DHF) annually that need hospitalization[47]. Dengue is unfold through the bite of Associate in Nursing infected arthropod genus aegyptimosquito. The dipteron gets the virus by biting Associate in Nursing infected person[48]. The primary symptom of the sickness seems in concerning 5-7 days when the infected dipteron bites a healthy person. It's potential to become infected by dandy fever multiple times as a result of the virus has four completely different serotypes. Though every infection confers long immunity thereto specific serotype, a consequent infection with a distinct serotype will increase the chance of getting the a lot of deadlier type referred to as dandy fever haemorrhagic fever (DHF)[49]. The symptoms of dengue embrace high fever, rash, and a severe headache (dengue triad). Extra symptoms embrace severe joint and muscular pain (break bone fever), nausea, vomiting, and eye pain. Though dengue itself isn't fatal, it are often an awfully painful and disabling unhealthiness and will become epidemic in a very population following the introduction of a brand new serotype. Dengue is typically a end unhealthiness, and solely auxiliary care is needed. Painkiller is also accustomed treat patients with symptomatic fever. Aspirin, Brufen anti-inflammatory drug medicine (NSAIDs), antibiotics and corticosteroids ought to be avoided as these don't facilitate however cause inflammation and/or trauma. In youngsters, Reye's syndrome (encephalopathy) is also a heavy complication. Patients with proverbial or suspected dengue ought

to have their thrombocyte count and Hematocrit measured daily from the third day of unhealthiness till 1-2 days when suspension. No immunizing agent is out there for the bar of dandy fever infection. Immunogenic, safe power vaccines are developed and are undergoing clinical trials. The sole thanks to stop dandy fever virus acquisition is to avoid being bitten by a vector dipteron[45-48].

Taxonomical Classification

Kingdom : Plantae Subkingdom : Tracheobionta Division : Magnoliophyta Class : Magnoliospida Family : Caricaceae Genus : Carica L. Species : Carica papaya L.	Varnacular Names Hindi : Papita English : Papaya Eclectics : Papaw Brazil : Mamao Caribbean : Ababaï Cuba : Fruta de bomba

Figure No.1: Papaya Fruits

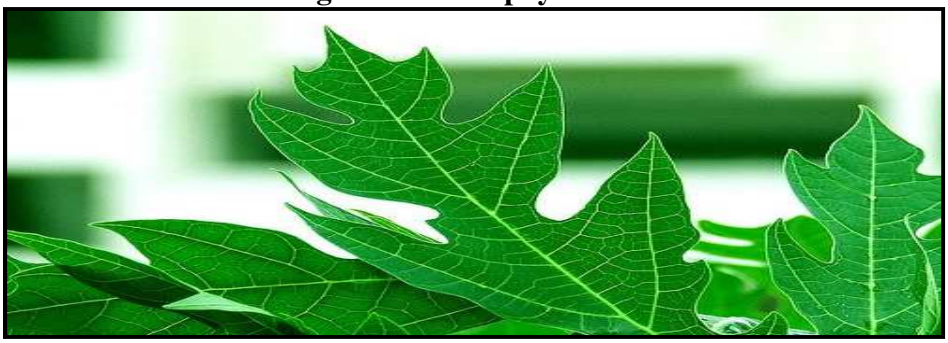
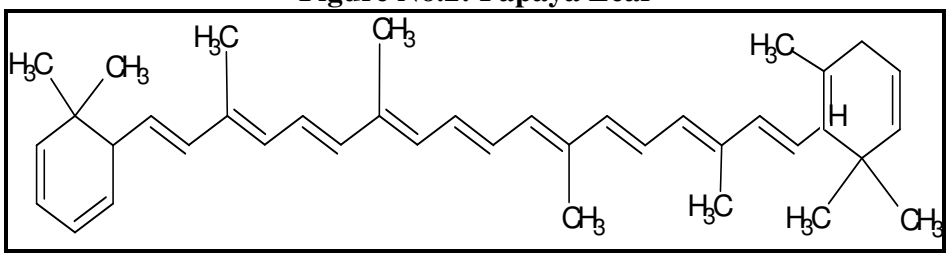
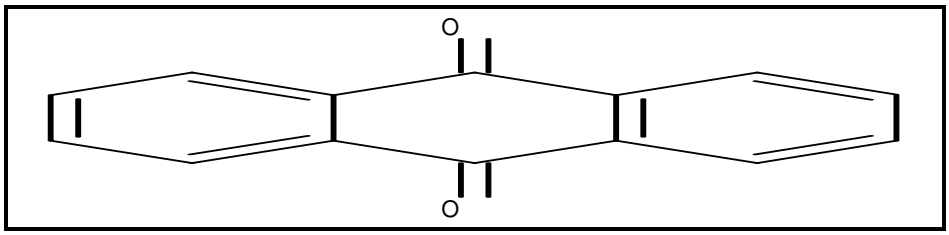


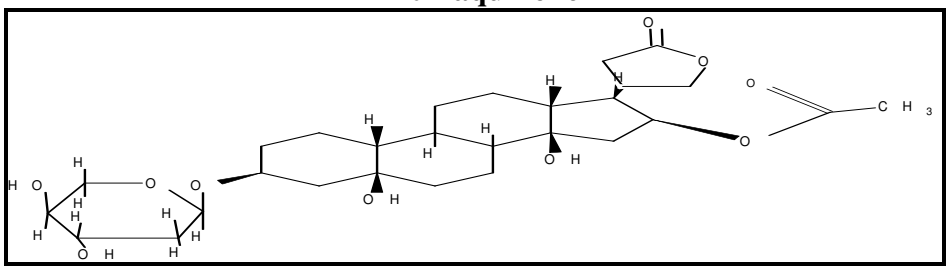
Figure No.2: Papaya Leaf



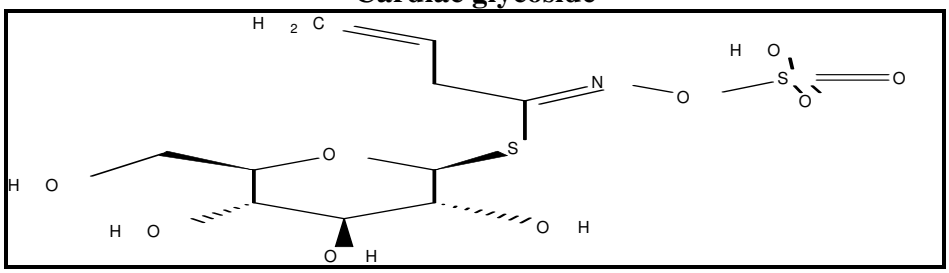
Beta- carotene



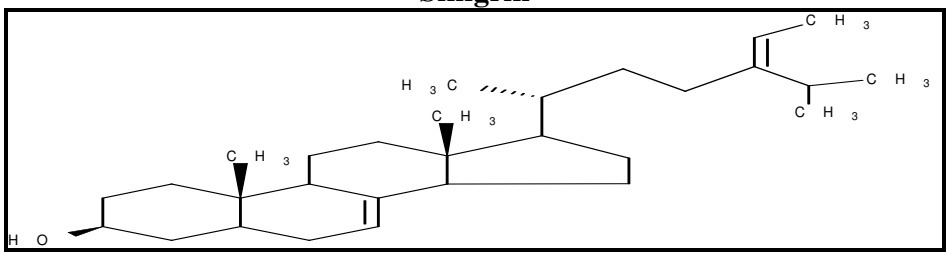
Anthraquinone



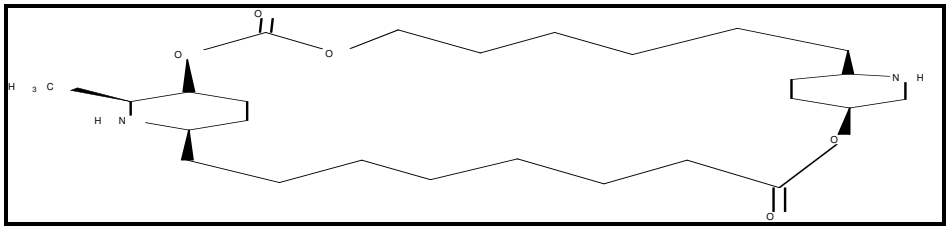
Cardiac glycoside



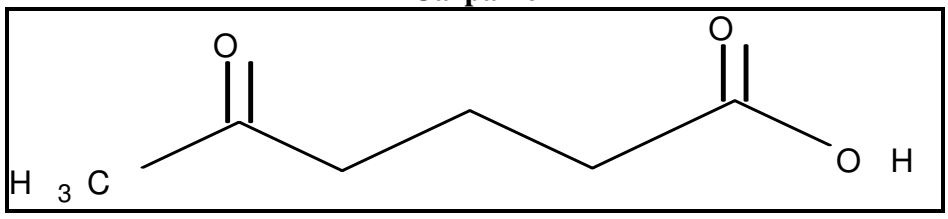
Sinigrin



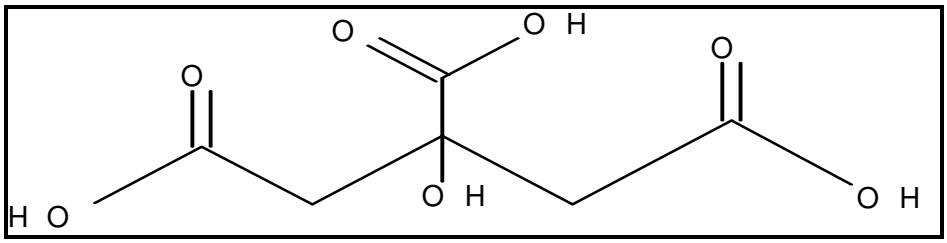
Avenasterol



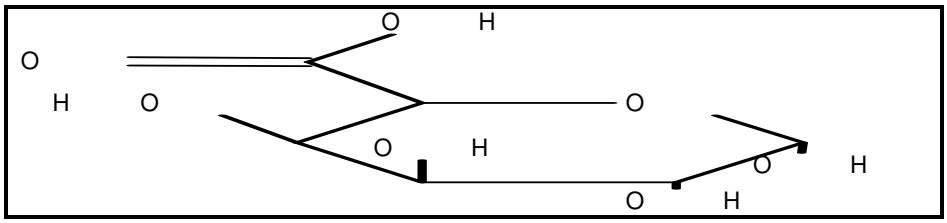
Carpaine



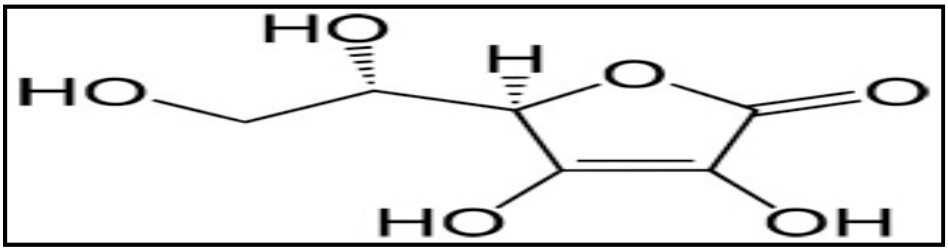
Glutaric acid



Citric Acid



Galactouronic acid



Ascorbic acid

CONCLUSION

Papaya plant is especially used because the food ingredient throughout the planet thanks to its fruits and its nutrient values. From the above studies about the papaya plant shows that the plant's leaves, stem, fruits and seeds also contains different chemical constituents such as Alkaloids carpain, pseudocarpain, dehydrocarpaine I and II, choline, carposide, Vitamin C and E. Carposide Associate in Nursingd an accelerator myrosin, sinigrin, Carpaine, benzylisothiocyanate, radical glucosinolate, glucotropacolin, benzylthiourea, hentriacontane, β-sitosterol, caricin, leaves connected alkaloids, flavonoids, saponins, tannins, cardiac glucoside, anthraquinones and cardinolodes etc. many of the pharmacological activities has been done on the papaya plants. But hence extensive investigations on its pharmacodynamics, kinetics, proper standardization and clinical trials are needed to exploit their therapeutics utility to cure many diseases.

ACKNOWLEDGEMENT

The authors wish to express their sincere gratitude to Department of Pharmacology, Pharmacy College Saifai UPUMS Saifai, Etawah, Uttar Pradesh, India for providing necessary facilities to carry out this review work.

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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Please cite this article in press as: Vikash Chandra *et al*. Chemical ingredients and pharmacological properties of *Carica papaya:* a review, *Asian Journal of Phytomedicine and Clinical Research,* 7(3), 2019, 129-140.