

Pharmacological and Medicinal Importance of *Passiflora Edulis*: A Review

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DOI: <https://doi.org/10.52403/ijrr.20220442>

ABSTRACT

Passiflora Edulis is passion fruits; because these fruits are of multiple pharmacological activities. This plant has medicinal properties basis for their uses as home remedies. *Passiflora edulis* largest Family is Passifloraceae. Passion Fruits used as multiple marketed products. Passion Fruits and whole plant are very useful it has Pharmacological activity like Antidiabetic, anxiolytic activity, Anti-tumour activity, anti-oxidant, Analgesic, anti-inflammatory. And also, lots of useable Chemical Constitutes is present like Volatile oil, flavonoids, Lipid and Triterpenoids, also present Aldehydes, ketones, tridecanone, Palmitic acid, Stearic Acid, Linolic Acid, Quercetic, Apigenin, Vitexin. This chemical constitutes are useful for the various Pharmacological Activity. This review Possible to provide Authentic information on plant related physiochemical features, nutritional Values, Pharmacological and biological activities, and potential used in marketing as

well as an herbal preparation of leaves, stems, fruits, and peels of *P. edulis*.

Keywords: *Passiflora Edulis*, Passion Fruits, Krishna Phal, Fruits.

INTRODUCTION

Passiflora edulis (Krishna Phal: Indian Name) well know Plant which have lots of Pharmacologically Activities and also have medically used for the Various Diseases treatment. The genus *Passiflora*, comprising around 500 species, *Passiflora* have Biggest in family Passifloraceae. Among which, the *Passiflora edulis* have many medicinal importance [1]. It comes from the *Passiflora* vine and is native to Brazil, Paraguay and Argentina. It is widely planted in especially in South America, Caribbean, south Florida, South Africa, and Asia As a member of the Passifloraceae family[2].



A. Flower & Fruits, Leaves



B. Flower



C. Passion Fruits

Figure: Fruits, Leaves, Flowers of *Passiflora Edulis*

SCIENTIFIC CLASSIFICATION [2]

Table 1: Scientific Classification of *Passiflora edulis*

Kingdom	Plantae
Family	<i>Passifloraceae</i>
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
(Unranked)	Eurosids I
Order	Malpighiales
Genus	<i>Passiflora</i> L.
Species	<i>Passiflora foetida</i> L.
Synonyms	<i>Passiflora edulis</i> var. <i>verrucifera</i> (Lindl.), <i>Passiflora edulis</i> forma <i>edulis</i>), <i>Passiflora verrucifera</i> (Lindl)

Few years ago, with the most effective work done on *P. edulis* development, passion fruit for human consumption due to the multiple eating of it's useable as a fruits, juiciness, attractive nutritional values, *P.edulis* give the essential health benefits[3]. Passion fruit, also known as a “the king of fruits”, “maracujá”, “love fruit”, and fruit lover. By the *P. Edulis* prepare the cake, ice cream, jam, jelly, yoghurt, compound beverage, tea, wine, vinegar, soup-stock, condiment sauce, and so on. Passion fruit is also used for herbal medicines and cosmetic moisturizing agent in many countries [4,5]. This plant has sweet properties, sour in flavor, and highly aromatic, and acts on the heart and large intestine meridians with the dose of 10 and 15 g when taken it orally as decoct soup for treatment of cough, hoarseness, constipation, dysmenorrhea, arthralgia, dysentery, insomnia [6]. In Brazil, the yellow passion fruit used for the preparation of soft drinks and as a remedy in folk

Herbal medicine, like juices nectars, tinctures or tablets [7]. The leaves of *P. edulis* with highly appreciated and pleasant taste are widely used as sedatives or tranquilizers United States and European countries. *P. Edulis*'s peels characterized by multiple ranges of polyphenols, fibers and trace elements, also used for making wine or tea, cooking dishes, extracting pectin and medicinal ingredients, and processing feed [8]. The seeds are edible because of it have high Contents in protein and oil mainly composed with linoleic acid, oleic acid, and palmitic acid. The principal components of *P. edulis* include polyphenols, triterpenes, and its glycosides, carotenoids, cyanogenic glycosides, polysaccharides, amino acids, essential oils, microelements, and so forth [9]. Among these compounds reported that is luteolin, apigenin, and quercetin derivatives. Most importantly; passion fruit contains nutritionally compounds like vitamin C, dietary fiber, B vitamins, niacin, iron, phosphorus, and so forth [10]. *P. edulis* performance in-vitro and in vivo pharmacological studies have revealed various promising bioactivities of *P. edulis*, such as antioxidant, antimicrobial, anti-inflammatory, anti-hypertensive, hepato-protective and lung-protective activities, anti-diabetic, sedative, antidepressant activity, and anxiolytic-like actions and many More. Most of these effects are consistent with those observed for *P. edulis* in traditional and folk medicine and these pharmacological actions are thought to be mostly mediated via the existed bioactive components including polyphenol, triterpenes, and polysaccharides. Several researchers have reviewed the botany, chemistry, and pharmacological reports with this Plants *Passiflora* genus [11]. However, to date, no comprehensive review concerning the information on the chemical and biological properties of *Passiflora. edulis* is available. The extraction methods and purification procedures for polysaccharides, processing passion fruit for formulation and production of food product is also reviewed [12].

Table 2: Plant information of *Passiflora Edulis*[12]

Vernacular Name	Passion fruit, Grenadine, Passion flower, Purple granadilla, Purple passion fruit and Grenadelle.
Description & Habitat	<i>Passiflora Edulis</i> grows in tropical and subtropical mesic to wet environments-especially forests and scrub, forest edges, forest gaps and riparian areas in forests.
Biology	<i>Passiflora edulis</i> is a perennial vine; tendrils are borne in leaf axils, and have a red or purple hue when young. There are two main varieties: a purple-fruited type, <i>P. edulis</i> , <i>f. edulis</i> , and the yellow-fruited.
Plant Description	Most passion flowers are climbing or prostrate vines with grasping tendrils; some are trees or shrubs. The plants can be herbaceous or woody. Its length is about 6 cm and it weighs about 60-90 g. The yellow form has a more vigorous vine and generally larger fruit than the purple. The yellow form has brown seeds. It has a firm, round, shiny shell.
Leaves	The simple leaves are entire or lobed.
Flowers	Most passion flowers are evergreen with dark green leaves and either white or purple blooms. Some passion flowers are suitable only for growing in a conservatory or greenhouse.
Fruits	The yellow <i>passion fruit</i> is 6–12 cm long and 4–7 cm in diameter. The peel is bright yellow, hard, and thick. The seeds are brown.

PHYSIOCHEMICAL COMPONENT

P. Edulis include main components with dietary fiber, carbohydrates, lipids, carboxylic acids, polyphenols, volatile compound, protein and amino acids, vitamins, mineral. To date, more than 110 chemical constituents have been identified from the *P. Edulis*. High contents of flavonoids, triterpenoids, and carotenoids are the primary types [13].

NUTRITIONAL COMPOSITION

Behalf of USFDA nutritional composition of purple and yellow passion fruit juice reported Food Composition Database. The data show evidence that the purple and yellow passion fruit juice contain a high percentage of carbohydrate, Vitamin A, Vitamin C, minerals, and fiber. In general, the nutritional composition content in purple passion fruit was basically the same as that in yellow variety.

Table 3: Essentials Nutrients List [13]

Nutrient (Unit)	Purple passion fruit juice, raw	Yellow passion fruit juice, raw
Water (g)	85.62	84.21
Protein (g)	0.39	0.67
Energy (kcal)	51	60
Carbohydrate (g)	13.5	14.44
Fiber & total dietary (g)	0.2	0.2
Sugars (g)	13.3	14.24

PECTIN, FIBER, AND POLYSACCHARIDES

Pectin, fiber, and polysaccharides are the most common functional ingredients in food products and exert a strong positive influence on human health. The contents of pectin, crude fiber and polysaccharides are 12.3%, 22.1%, and 20.65%, respectively

[14]. *P. edulis* seed is rich with insoluble dietary fiber (64.0%). After defatting, the insoluble fiber-rich fractions (84.8%-93.2%) including cellulose, pectic substances, and hemicellulose become the predominant components [15]. GC-MS showed that polysaccharides from the peel of yellow passion fruit are composed of galacturonic acid (44.2%), arabinose (11.8%), glucose (11.8%), maltotriose (10.6%), mannose (9.0%), galactose (6.1%), xylose (3.6%), ribose (1.3%) and fucose (1.6%), and so forth. [16]. Meanwhile, yellow passion fruit have naturally low-methoxylpectin. Polysaccharide from purple passion fruit peel is mainly composed of galacturonic acid (80.32%), glucose (4.65%), ribose (4.41%), galactose (3.84%), arabinose (3.53%), mannose (1.34%), xylose (0.72%) and rhamnose (0.17%), and so forth. We found 14-linked galacturonic acid is the main component of polysaccharides from yellow and purple passion fruit. Diverse studies have demonstrated that pectin and fibers from *P. edulis* peel can effectively eliminate free radicals such as DPPH and ABTS [16], reduce cholesterol and blood glucose levels [17] and obviously inhibit the growth of sarcoma180 [18], and so forth. Thus, the passion fruit peel may be utilized in the development of new fiber-rich healthy food products.

PROTEIN AND AMINO ACIDS

The total protein content from fruit pulp of passion fruit is 0.80 mg/g [19]. Importantly, some proteins in passion fruit have promising antifungal properties. For

example, Pe- AFP1 (5.0 kDa), a 2S-albumin-protein-like peptide purified from the seeds of passion fruit, is found to be able to inhibit the growth of filamentous fungi *Trichoderma harzianum*, *Fusarium oxysporum*, and *Aspergillus fumigatus* with a respective IC₅₀ values of 32, 34, and 40 mg/ml [20]. Free amino acids isolated from purple passion fruit mainly include leucine, valine, tyrosine, proline, threonine, glycine, aspartic acid, arginine, and lysine. Among them, lysine, threonine, leucine, and valine are indispensable amino acids for growth.

VOLATILE COMPONENTS

Passion fruit have Volatile components these components are response for the anti-oxidative activity. The esters (59.24%), aldehydes (15.27%), ketones (11.70%), alcs. (6.56%), terpenes, and other miscellaneous compounds have been proven to exist in passion fruit [21]. GC and GC-MS analysis revealed that the major volatile constituents of fruit shell of *P. edulis* Sims are 2-tridecanone (62.0%), (9Z)-octadecenoic acid (16.5%), 2-pentadecanone (6.2%), hexadecanoic acid (3.2%), 2-tridecanol (2.1%), octadecanoic acid (2.0%), and caryophyllene oxide (2.0%) [22]. It is noteworthy that the volatile components changed during maturation.

LIPIDS

P. edulis seeds contain 20% drying oil, solid fat acid 11.5% (palmitic and stearic acids) and 88.5% liquid acid (linolic and oleic acids). Seeds oil contain high amount of unsaturated fatty acids, and the major unsaturated fatty acids are linoleic acid (69.3%), oleic acid (14.4%), palmitic acid (10.1%), and stearic acid (2.8%) [23]. The total content of crude oil in the residue of passion fruit after juice production is ~24%.

FLAVONOIDS

The passion fruit pulp is a famous for food source of flavonoids Contents, which contains 158.0 mg/ml of total flavonoids, 16.2 mg/ml of isoorientin[24,

25] and 0.42 mg/g of quercetin. The aerial parts of *P. edulis* extracted by reflux with 40% ethanol contain 0.90% of apigenin. So far, 33 flavonoids have been identified in various parts of *P. edulis* [26]. Among them, the major flavonoids identified from *P. edulis* are vitexin, isovitexin, isoorientin, apigenin, quercetine, luteolin, and their derivatives [13,27] which represent important classes of effective compounds in *P. edulis* regarding their various biological and pharmacological properties [28].

TRITERPENOIDS

Approx Twenty nine triterpenoids varying in chemical structures have been isolated from fruits, leaves, stems, and roots of *P. edulis* [29]. Cycloartane triterpenoids have showed the significant protective effects against damage of PC12 cell induced by glutamate, which can be used for the treatment of neurodegenerative disease [30]. Cycloartane triterpenoids cyclopassiflosides IX and XI at 50 mg/kg displayed antidepressant-like effect [31]. Alkaloids, Alkaloids including harmidine, harmine, harmane, harmol, Ntrans- feruloyltyramine, and cis-N-feruloyltyramine have been found in fruits and leaves of *P. edulis* [32]. Harmine, a fluorescent harmala alkaloid, can reversibly inhibit monoamine oxidase A and angiogenesis and suppress tumor growth. Meanwhile, it showed anti-inflammatory activity by significantly inhibiting the NF- κ B signaling pathway [33,34].

SULFORAPHANES AND CAROTENOIDS

Six sulforaphanes and 13 carotenoids have been isolated and identified in fruits of *P. edulis* [35, 36]. Carotenoids from vegetables and fruit play important roles in physiological functions, and thus have health benefits including anti-obesity, antidiabetic, and anticancer activities [37].

PHARMACOLOGICAL ASPECTS ANTI-INFLAMMATORY

The aqueous extract of *P. edulis* leaves and two derived fractions of butanolic and aqueous residue exhibited potent anti-inflammatory action in the experimental model in vivo. The aqueous leaves extract of *P. edulis* (100-1000 mg/kg, i.p.) possess a significant anti-inflammatory activity on carrageen an-induced pleurisy in mice. The systemic administration of *P. edulis* exhibited pronounced anti-inflammatory actions, characterized by inhibition of leukocyte influx to the pleural cavity and associated with marked blockade of myeloperoxidase, nitric oxide, TNF α and IL-1 β levels in the acute model of inflammation caused by intra pleural injection of carrageenan. Furthermore, this extract was effective in inhibiting leukocytes in the pleurisy induced by bradykinin, histamine and substance-P. In these experiments *P. edulis* and dexamethasone almost equally lowered the leukocytes, myeloperoxidase and nitric oxide levels in the first phase of the inflammatory response induced by carrageenan in mice. In another experiment, *P. edulis* was more effective in suppressing the TNF α and IL-1 β levels than dexamethasone. So, *P. edulis* may be a source of new therapeutic candidates with a spectrum of activity similar to the current anti-inflammatory steroids such as dexamethasone [38,39].

ANTI-HYPERTENSIVE ACTIVITY

The anti-hypertensive activity of both yellow and purple passion fruit products has been proved in spontaneously hypertensive rats. Oral administration of *P. edulis* peel extract reduced hemodynamic parameters, decreased serum nitric oxide level, and lowered blood pressure in spontaneously hypertensive rats. This could be attributed to the polyphenols such as luteolin, luteolin-6-C-glucoside, quercetin, edulilic acid, ascorbic acid, piceatannol and anthocyanin, and so forth. Which can mediate nitric oxide modulation and have

potent vascular effects. However, the exact mechanisms and compounds responsible for this effect need further investigation [40].

HEPATOPROTECTIVE AND LUNG-PROTECTIVE ACTIVITIES

Oral administration of purple passion fruit peel extract showed Hepato-protection against chloroform (1 mmol)-induced rat liver injury and showed noteworthy hepatoprotective activity against CCl $_4$ induced hepatotoxicity. In ethanol-induced liver injury, treated daily with fruit juices to mice for 15 days could protect ethanol-induced liver injury by decreasing AST and ALT in liver, and alleviating the inflammation, oxidative stress. In addition, the passion fruit seed extract prevented non-alcoholic fatty liver disease by improving the liver hypertrophy and hepatic histology of the high-fat diet-fed rats. In a pulmonary fibrosis of C57BL/6J mice model induced by bleomycin, administration of passion fruit peel extract significantly reduced loss of body weight and mortality rate decreased the count of inflammatory cells, macrophages, lymphocytes, and neutrophils, reduced MPO activity and restored bleomycin induced depletion of SOD activity [41].

ANTIOXIDANT

The *Passiflora Edulis* leaves have antioxidant activity. *P. edulis* hydro-alcoholic leaf extracts were verified in in-vitro and ex-vivo assays. The antioxidant activity of *P. edulis* leaves extract was significantly correlated with polyphenol contents. In addition, *P. edulis* attenuated ex vivo iron-induced cell death, quantified by lactate dehydrogenase leakage, and effectively protected against protein damage induced by iron and glucose. The antioxidative capacity of *P. edulis* leaves was also checked against DPPH radical and several reactive oxygen species (superoxide radical, hydroxyl radical, and hypochlorous acid), revealing it to be concentration-dependent, although a pro-oxidant effect was noticed for hydroxyl radical. These findings demonstrated that the *P. edulis* leaf

extract have potent in-vitro and ex-vivo antioxidant properties and might be considered as possible new sources of natural antioxidants. Further studies are needed to examine the potential use of *P. edulis* extract in the prevention of pathologies, such as diabetes mellitus and neurodegenerative diseases, where oxidative stress damage to protein seems to play a major role[42].

ANTITUMOR ACTIVITY

Most of the pharmacological work has been carried out on the antitumor activity of *P. edulis*. In vitro, the different varieties of extracts of *P. edulis* showed cytotoxicity against HepG2, MCF-7, SW480, SW620, Caco-2 CCRF-CEM, CEM/ADR5000, and HCT116 [p53(-/-)]. It was found that higher content of polyphenolic and polysaccharide contained in ethanolic extract may be related to the inhibition of matrix-metalloprotease MMP-2 and MMP-9. In vivo, the ethanol extract of yellow passion fruit inhibited tumor growth with an inhibition rate of 48.5% and increased mice lifespan to nearly 42% in male Balb/c mice inoculated with Ehrlich carcinoma cells. This could be attributed to the presence of medium and long chain fatty acids such as lauric acid. Oral (P.O) or intraperitoneal (I.P) administration of the polysaccharide showed the inhibition of the growth of sarcoma 180 tumors with an inhibition ratio ranging from 40.59% to 48.73% [43].

ANTIDIABETIC ACTIVITY

Diverse studies have demonstrated that peel flour, juice, and seeds of *P. edulis* showed antidiabetic potential effects by reducing glucose tolerance in diabetic mice and rats. Oral administration of passion fruit juice at a dose of 580 mg/kg once a day for 30 consecutive days

Significantly reduced glucose in streptozotocin (STZ) induced diabetic rat offspring and administration of passion fruit seed or leaf extract also reduced the blood glucose levels of db/dbmice, alloxan induced diabetes mellitus in Wistar albino

rats or streptozotocin (STZ) induced diabetic rats. Oral administration of pectin from *P. edulis* fruit peel at a dose of 0.5–25 mg/kg daily for 5 days lowered blood glucose in diabetic rats induced by alloxan, providing a new treatment for type 2 diabetes. Peel flour of *P. edulis* intake increased glucose-dependent insulinotropic polypeptide and glucagon-like peptide-1, improved the insulin sensitivity in high-fat diet-induced obesity rats by increasing the glucose disappearance rate and also prevents insulin resistance induced by low-fructose-diet in rats. In addition, the leaf extract of *P. edulis* full of flavonoids also has a health benefit to the diabetic state, and show the prevent effect on the appearance of its complications [44].

ANXIOLYTIC-LIKE ACTIVITY

P. Edulis extracts like butanolic, methanol, ethanol, hydro-ethanol, and aqueous extract showed anxiolytic-like effect in the model tested. The aqueous extract of *P. edulis* at 50, 100, and 150 mg/kg showed anxiolytic-like effects in the elevated plus-maze and inhibitory avoidance tests in rat. The leaf of *P. edulis* Sims is most used as a medicine in treating anxiety. More importantly, administration of the aqueous extract of *P. edulis* did not disrupted rat memory process in a habituation to an open-field test, but diazepam impaired rat habituation with a simple modification of the open field apparatus. The methanol extract of aerial parts of *P. edulis* Sims at an oral dose of 75 mg/kg showed anxiolytic activity on the elevated plus-maze model of anxiety in mice, but oral dose of 125 mg/kg did not evoke any significant activity. Whereas, oral at higher doses of 200 and 300 mg/kg showed a mild sedative effect. Pre-treatment with 50, 100, and 150 mg/kg hydro ethanol extracts and 400 and 800 mg/kg of spray dried powders of *P. edulis* leaves also showed anxiolytic activity in the elevated plus-maze test in mice. It was suggested that the therapeutic effect of these extracts was due to the presence of a wide range of

flavonoids such as isoorientin, orientin, luteolin, apigenin, and chrysin or their glycosides, and so forth [44].

ANALGESIC ACTIVITY

Studies showed that n-butanol extracts of *P. edulis* leaves had a dose-dependent analgesic activity in a thermal stimulation pain model. In acetic acid-induced writhing, formalin-induced paw licking and response latency in the Eddy's hot plate test, the polysaccharide of the dried fruit of the *P. edulis* reduced acetic acid induced writhing and formalin-induced paw licking, but it did not produce a significant increase in reaction time in the hot plate test, suggesting that the analgesic activity of polysaccharide is related to peripheral mechanisms [43].

CONCLUSION

Passion Fruits are the most famous and popular medicinal plant as well marketed Preparation plant because in the marketed jam juice herbal medicine is demand is high. In India this plant name is Krishna Phal as well as it is an eating fruits because its use for the Tea, juice, cake flavor, Jam, Jelly, Cream. *P. Edulis* have fatty acids are linoleic acid (69.3%), oleic acid (14.4%), palmitic acid (10.1%), and stearic acid (2.8%). *P. Edulis* has Valuable Nutritional Value like Protein, Water, Carbohydrates, and Energy. In Brazil *P. Edulis* used in soft drink. Carotenoids which are present in *P. Edulis* vegetables and fruit play important roles in physiological functions thus have health benefits including anti-obesity, antidiabetic, and anticancer activities.

Acknowledgement: The authors greatly acknowledge the support provided by Kota College of Pharmacy, Kota, Rajasthan, India.

Conflict of Interest: The authors Smiriti Rai, Mohammad Mukim, Jagdish Chandra Nagar, declare that there is no conflict of interest.

Source of Funding: None

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How to cite this article: Smiriti Rai, Jagdish Chandra Nagar, Mohammad Mukim. Pharmacological and medicinal importance of *passiflora edulis*: a review. *International Journal of Research and Review*. 2022; 9(4): 341-349. DOI: <https://doi.org/10.52403/ijrr.20220442>
