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Review Article

Passiflora Edulis: Phytochemical Analysis and Pharmacological Aspects

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ABSTRACT

The passion fruit, Passiflora edulis, has a variety of pharmacological properties. The rationale for this plant's use as a home remedy is its therapeutic qualities. Among Passiflora edulis, the Passifloraceae is the largest family. Passion Fruits are utilized as a variety of items. The entire plant, including the fruits, has many medicinal properties, including anti-inflammatory, anti-tumor, anti-tumor, analgesic, and antioxidant properties. Numerous useful chemical constituents are also present, including volatile oil, flavonoids, lipids, triterpenoids, aldehydes, ketones, tridecanone, palmitic acid, stearic acid, linolic acid, quercetic, apigenin, and vitexin. These chemical constituents have a variety of pharmacological applications. The physiochemical characteristics, nutritional values, pharmacological and biological activities, and possible applications in marketing are all authenticated by this review. Passiflora edulis, or passion fruit, is a unique climbing vine. Passion fruit is presently farmed all over the world as an edible fruit for the food industry, having originated in South America. Traditional medicine in South America and other nations has made extensive use of it to treat bronchitis, asthma, anxiety, sleeplessness, and urinary tract infections. Different extracts of P. edulis contain flavonoids, alkaloids, cyanogenic chemicals, glycosides, vitamins, minerals, and terpenoid compounds as their main phytoconstituents.The tropical vine Passiflora edulis is widely cultivated for both its therapeutic and scrumptious fruits. It has been discovered that the seeds of this fruit, which is typically thrown away, are rich in protein, dietary fiber, phytochemicals, and vital minerals. Reviewing the literature on the phytochemical makeup and medicinal use of Passiflora edulis seeds is the aim of this study. The seeds themselves may have antibacterial, anti-inflammatory, anti-diabetic, and antioxidant qualities, making them potentially therapeutic. Research has been done on the seeds' potential for treating illnesses, making organic sunscreen, and using them in medications, cosmetics, and skin care products. The medical application of Passiflora edulis seeds is well supported by these investigations. But further study is needed. Nevertheless, additional investigation is required to identify a particular candidate molecule that may be beneficial in next medication formulations.

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According to this study, more investigation into the pharmacological characteristics of Passiflora edulis seeds is necessary in order to create a novel medicinal chemical that may be applied to the treatment of illnesses or employed in cosmetic products.

INTRODUCTION

A member of the Passifloraceae family, the passion fruit (Passiflora edulis) is cultivated for its distinct flavor and fragrant juice and is also a significant cash crop and medicinal fruit. This tropical vine, which thrives in hot, humid climates, is widely grown from the tropics to the subtropics worldwide.[28,29] The primary focus of Passiflora species cultivation is on their aesthetically pleasing and tasty fruits, as well as their potential uses in pharmaceuticals. The fruit has seeds inside its luscious, firm, and moist interior. The fruit's peel and seeds contain a number of phytochemical components and medical value, however the fruit juice is the main source of income. After the juice is recovered, these seeds are typically crushed and thrown away and juice is extracted from the pulp of fruit Nonetheless, research has shown that the seeds of P. edulis f. flavicarpa and Passiflora edulis Sims are both edible and high in oil. Despite being sometimes disregarded, passion fruit seeds are a wonderful source of protein, dietary fiber (which aids in digestion), and vital minerals like iron and magnesium. Additionally, the seeds contain bioactive components that can guard against oxidative damage and are known to help with type 2 diabetes and cardiovascular disorders, such as piceatannol, polyphenolic, and anti-inflammatory chemicals.[30] Typically, passion fruit seeds are added to a variety of recipes to give them an additional nutty flavor. manufacturing of fruit pulp and salads, desserts, and even milk shakes. They may also be used as a moisturizer in food and cosmetic applications due to their high oil content.[31,32] In order to investigate these seeds' numerous other qualities and applications, more research is therefore required. The qualities of the Passiflora edulis seeds discussed in several papers and their potential applications in the pharmaceutical industry are thoroughly reviewed in this article. In the United States and Europe, P. edulis leaves, which have a highly valued and agreeable taste, are frequently used as sedatives or tranquilizers. Peels from P. edulis, which are rich in fibers, trace elements, and a variety of polyphenols, are also used to make tea or wine, cook food, extract pectin and other therapeutic compounds, and process feed. The seeds' high protein and oil content, which is mostly made up of palmitic, oleic, and linoleic acids, makes them palatable. Polyphenols, triterpenes and their glycosides, carotenoids, cyanogenic glycosides, polysaccharides, amino acids, essential oils, microelements, and so on are the main constituents of P. edulis . These substances include derivatives of quercetin, luteolin, and apigenin. Above all, passion fruit includes nutritious substances including vitamin C, Dietary fibers, B vitamins, niacin, and iron phosphorous.[6,7]

Fig: Passiflora Edulis

Taxonomical classification:

Kingdom	Plantae
Family	Passifloraceae
Division	Magnoliophyte
Class	Magnoliopsida
Subclass	Rosidae
Order	Malpighailes
Genus	Passiflora l.
Species	Passiflora foetida l.
Synonyms	Passiflora edulis var.

Nutritional Composition:

Pectin, Fiber, Polysaccharides:

Polysaccharides, fiber, and pectin The three most prevalent functional components in food products—pectin, fiber, and polysaccharides—have a significant favorable impact on human health. 12.3%, 22.1%, and 20.65% of the total are pectin, crude fiber, and polysaccharides, respectively. There is a lot of insoluble dietary fiber (64.0%) in P. edulis seeds. The insoluble fiber-rich fractions (84.8%–93.2%) that remain after defatting, such as cellulose, pectic compounds, and hemicellulose, take center stage . GC-MS revealed that the polysaccharides found in the peel of yellow passion fruit are made up of galacturonic acid (44.2%), glucose (11.8%), arabinose (11.8%), maltotriose (10.6%), mannose (9.0%), galactose (6.1%), xylose (3.6%), ribose (1.3%), and fucose (1.6%), etc. On the other hand, yellow passion fruit has a low methoxylpectin content by nature. Purple passion fruit peel polysaccharide is primarily made up of galacturonicis the main component of polysaccharides from yellow and purple passion fruit.[3,4]

Volatile Components:

Passion fruit has Volatile components are those that react to anti-oxidative action. The presence of several chemicals in passion fruit has been established, including terpenes, aldehydes (15.27%), ketones (11.70%), alcs (6.56%), and esters (59.24%) [21]. The primary volatile components of P. edulis Sims fruit shell were determined by GC and GC-MS analysis to be 2-tridecanone (62.0%), (9Z)octadecenoic acid (16.5%), 2-pentadecanone (6.2%), hexadecanoic acid (3.2%), 2tridecanol (2.1%), octadecanoic acid (2.0%), and caryophyllene oxide (2.0%) [22].

Notably, the volatile components underwent changes as they matured.[2]

Lipids:

The seeds of P. edulis contain 20% drying oil, 11.5% solid fat acid (stearic and palmitic acids), and 88.5% liquid acid (oleic and linolic acids). There are a lot of unsaturated fatty acids in seed oil, and the main unsaturated**.** The fatty acids are stearic acid (2.8%), palmitic acid (10.1%), oleic acid (14.4%), and linoleic acid (69.3%). After passion fruit juice is produced, the residue contains about 24% crude oil overall.[17,18]

Flavonoids:

Flavonoids are a well-known dietary source of flavonoids, with the pulp of passion fruit having 158.0 mg/ml of total flavonoids, 16.2 mg/ml of isoorientin , and 0.42 mg/g of quercetin. The amount of apigenin in P. edulis aerial parts extracted by reflux with 40% ethanol is 0.90 percent. 33 flavonoids have been found in P. edulis sections thus far . Among them, the main flavonoids found in P. edulis are luteolin, quercetine, apigenin, isovitexin, isoorientin, and their derivatives, which are significant families of useful compounds in P. edulis.[11,12]

Triterpenoids:

About From P. edulis fruits, leaves, stems, and roots, 29 triterpenoids with different chemical structures have been identified . In the therapy of neurodegenerative diseases, cycloartane triterpenoids have demonstrated strong protective benefits against glutamate-induced damage to PC12 cells . At 50 mg/kg, the cycloartane triterpenoids cyclopassiflosides IX and XI showed an action akin to an antidepressant . Alkaloids P. edulis fruits and leaves include alkaloids such as harmidine, harmine, harmane, harmol, Ntrans-feruloyltyramine, and cis-Nferuloyltyramine . Harmine, a fluorescent harmala alkaloid, has the ability to reduce tumor growth and reversibly block angiogenesis and monoamine oxidase A. Meanwhile, it strongly inhibited the NF-kB signaling pathway, demonstrating antiinflammatory effects.[14,15]

Carotenoids and sulforaphanes:

In P. edulis fruits, 13 carotenoids and six sulforaphanes have been discovered and extracted . Because they are essential for physiological processes, carotenoids found in fruits and vegetables have anti-obesity, antidiabetic, and anticancer properties .[19]

Amino acids and Proteins:

Passion fruit pulp has a total protein level of 0.80 mg/g . Crucially, there are proteins in passion fruit that show promise as antifungals. For instance, it has been discovered that the 2S-albumin-protein-like peptide Pe-AFP1 (5.0 kDa), which was isolated from passion fruit seeds, may stop the growth of filamentous fungus Trichoderma harzianum, Fusarium oxysporum, and Aspergillus fumigatus. Its IC50 values are 32, 34, and 40 mg/ml, respectively . Leucine, valine, tyrosine, proline, threonine, glycine, aspartic acid, arginine, and lysine are the principal free amino acids that have been extracted from purple passion fruit. Leucine, valine, threonine, and lysine are essential amino acids for growth.[20,21]

Extraction Method:

Preparation of the Sample-

The local farmer in Bukit Tinggi, Pahang, Malaysia, was the supplier of the passion fruit. The

only passion fruit chosen was fresh and undamaged. After the fruit was cleaned with running tap water, the pulp and peel were separated. Using a universal oven UFB 500 (Memmert GmbH & Co. KG, Schwabach, Germany), the passion fruit peels were uniformly sliced into 1 cm3 pieces and baked at 45°C until a consistent weight was achieved. A laboratory grinder was used to crush the oven-dried samples into powder prior to extraction, and a DZQ 400/500 single vacuum chamber packager (Rotech Pharmaceutical Engineering Co., Ltd., Shanghai, China) was used to vacuum. The material was kept at -20°C until it was time for additional analysis.[23,24]

Sample Extraction:

The powder from passion fruit peels (5 g) was extracted using an IncuShake MINI benchtop incubation shaker (SciQuip, Staffordshire, UK) and 50 ml of aqueous ethanol at a 1:10 ratio. The mixture was then shaken at 150 rpm for 60 minutes at room temperature (25°C). Whatman No. 1 filter sheets were used to filter out the remnants. A benchtop centrifuge Mikro 200 (Hettich, Tuttlingen, Germany) was used to collect the leftovers, re-extract them using the aqueous solvent, and then centrifuge them for 15 minutes at 4500 rpm. A Rotavapor® R-210 rotary evaporator (Buchi, Flawil, Switzerland) was used to concentrate the supernatants at 40°C. Prior to additional analysis, the concentrated extract was freeze-dried and kept at -20°C. For every extraction condition, three separate extractions of the peel powder were made.[25,26]

Botanical Character:

Fruit:

Both varieties' fruit is regarded as climacteric, producing a lot of ethylene. The purple passion fruit plant produces spherical, egg-shaped, dark-purple or almost black fruit that is 5 cm long and weighs between 30 and 45 g.The yellow passion fruit is larger and slightly longer (6 cm) than the purple variety, but it is still deep yellow and has a similar form. It weights between 60 and 90 g on average. The fruit itself is oval or almost spherical, with a width of 1 1/2 to 3 inches (4-7.5 cm). It features a layer of white pith encased in a robust, thick, smooth, waxy rind. There is a chamber inside the fruit that contains up to 250 tiny black seeds in the shape of wedges.The juicy, edible portion of the fruit is contained in the deep orange sac that envelops the seed. The fruit has a pleasing flavor that ranges from subacid to acidic, with guava-like and musky undertones.[22,27]

Flowers:

Passion fruit is a popular plant for aesthetic reasons and is frequently used as an ornamental plant since it boasts some of the most distinctive and beautiful flowers. Depending on the kind of passion fruit, the clock-like blooms have five petals, three huge, green, leaf-like bracts, a diameter of around 4.5–6 cm, and are white and purple-blue (particularly in the center). The flower also has an ovary, five stamens with big anthers, and a triple-branched style that creates a noticeable central structure.13,16

Pollination:

Passion vines require pollination in order to produce fruit. Purple passion vine flowers typically bear fruit when they self-pollinate. Still, a lot of yellow passion vines will only bear fruit if pollen from another genetically suitable vine is deposited on their flowers. For normal fruiting,

passion needs mild temperatures. During the warmest period of the hot season, passion may flower but not set any fruit or produce fruit that is distorted. The bee is the most efficient pollinator of passion fruit. Fruit may naturally occur and sufficient pollination may be guaranteed by the native bee population. Although they are ideal, yellow passion fruit flowers are self-sterilizing. Because of compatibility, purple must be used as the seed parent when crossing yellow and purple forms; the other color does not function.[8,9,10]

Pharmacological Aspects:

Anti-inflammatory Activity:

In the in vivo experimental paradigm, the aqueous extract of P. edulis leaves and two derived fractions of butanolic and aqueous residue shown strong anti-inflammatory activity. Mice with carrageen an-induced pleurisy exhibit a notable reduction in inflammation when treated with an aqueous extract of P. edulis leaves (100–1000 mg/kg, i.p.). Systemic P. edulis administration demonstrated strong anti-inflammatory effects, including a marked blockage of myeloperoxidase and nitric oxide and an inhibition of leukocyte inflow to the pleural cavity.[5]

Anti-hypertensive Activity:

In rats with spontaneous hypertension, the antihypertensive properties of both purple and yellow passion fruit products have been demonstrated. In spontaneously hypertensive rats, oral administration of P. edulis peel extract decreased blood pressure, serum nitric oxide levels, and hemodynamic parameters. Polyphenols include luteolin, luteolin-6-C-glucoside, quercetin, edulilic acid, ascorbic acid, piceatannol, and anthocyanin, among others, may be responsible for this. which have strong vascular effects and can facilitate nitric oxide regulation. However, more research is necessary to determine the precise processes and substances causing this effect.[1]

Antioxidant Activity:

The leaves of Passiflora edulis exhibit antioxidant properties. Hydroalcoholic leaf extracts from P. edulis were confirmed in both in vitro and ex vivo tests. The polyphenol levels and the antioxidant activity of P. edulis leaf extract were substantially connected. Furthermore, P. edulis successfully prevented protein damage brought on by iron and glucose and reduced ex vivo iron-induced cell death as measured by lactate dehydrogenase leakage. P. edulis leaves' antioxidant ability was also tested against DPPH radical and a number of reactive oxygen species, including superoxide radical, hydroxyl radical, and hypochlorous acid. The results showed that it was concentration-dependent, though the hydroxyl radical had a prooxidant effect.[6,7]

Antitumor Activity:

It was discovered that the inhibition of matrix-metalloprotease MMP-2 and MMP-9 may be connected to the increased concentration of polyphenolic and polysaccharide in the ethanolic extract. In male Balb/c mice infected with Ehrlich carcinoma cells, the ethanol extract of yellow passion fruit extended the mice's lifespan to about 42% and suppressed tumor growth with an inhibition rate of 48.5% in vivo. The existence of medium and long chain fatty acids, including lauric acid, may be the cause of this. The growth of sarcoma 180 tumors was inhibited by oral (P.O.) or intraperitoneal (I.P.) injection of the polysaccharide, with an inhibition ratio ranging from 40.59% to 48.73%.[13,19]

Antidiabetic Activity:

Numerous investigations have revealed that P. edulis peel flour, juice, and seeds may have antidiabetic benefits by lowering glucose tolerance in diabetic rats and mice. Passion fruit juice taken orally once day for 30 days in a row at a dosage of 580 mg/kg The injection of passion fruit seed or leaf extract also decreased the blood glucose levels of db/dbmice, alloxan-induced diabetes mellitus in Wistar albino rats, or streptozotocin (STZ)-induced diabetic rats. Significantly lower glucose was found in the offspring of streptozotocin (STZ)-induced diabetic rats.[25,28]

Analyzation Activity:

Research revealed that in a thermal stimulation pain paradigm, n-butanol extracts of P. edulis leaves exhibited dose-dependent analgesic efficacy. The polysaccharide of the dried fruit of P. edulis decreased acetic acid-induced writhing, formalin-induced pawlicking, and response latency in the Eddy's hot plate test. However, it did not significantly increase reaction time in the hot plate test, indicating that the analgesic activity of polysaccharide is linked to peripheral mechanisms. [18,20]

CONCLUSION:

Passiflora species can be found all over the world. According to their research, this native medication is a promising option for bioprospection and medication development for the treatment of conditions including postmenopausal syndrome, cancer, anxiety, sleeplessness, convulsions, sexual dysfunction, coughing, and coughing. This plant's therapeutic uses and innumerable research opportunities are still present in its more recent fields of function. In this review, the chemical ingredients are thoroughly described. The brain, blood, cardiovascular, and nervous systems, as well as various biochemical and physiological processes like proteosynthesis, work capacity, reproduction, and sexual function, have all been found to be pharmacologically affected by a wide range of preparations, extracts, and individual compounds derived from this species.Hence, phytochemicals and minerals of these plants will enable to exploit its therapeutic use.

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