Passiflora a Promising medicinal plant

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Abstract

In nature, herbs are extensively studied for their large therapeutical interests and benefits. Plants, which are a source of phytochemicals with strong antioxidant activity, have attracted a great deal of attention in recent years. The *Passiflora* belongs to family *Passiflora*ceae has been used in diet as well as in medicine by a number of traditional medicine practitioners.

The present review describes the pharmacognostical, phytochemical, nutritional, antioxidant and bioactivity of the genus *Passiflora*. In *Passiflora* species, the number of secondary metabolites, organic acids, and volatile components have been recorded as the significant constituents. A number of *Passiflora* species have been used to treat a wide variety of disorders. Following the analysis of the acquired data, it was determined that the genus *Passiflora* has potential for further study. To determine the nutritional value and medicinally relevant phytoconstituents that will aid in the treatment of various disorders.

Key words: *Passiflora*, microscopy, traditional uses, phytochemical, nutritional, pharmacognostical and pharmacological studies

Introduction

The family *Passiflora*ceae includes the genus *Passiflora*, which contains about 400 species (Montanher *et al*., 2007; Beninca *et al*., 2007). The genus *Passiflora* is most common in warm and tropical regions. *Passiflora* gets its name from the Latin word "Passio."In 1529 Spanish discoverers discovered and nominated as a symbol the "Passion of Christ" (Kinghorn, 2001 and Dhawan*et al.,* 2004). *Passiflora* is a woody climber used in gardens as a decorative plant. In India, *passiflora* is known as passion fruit, and Maharashtra residents refer to it as Krishna Kamal.

Passiflora was widely used as a traditional medicine in West India, Mexico, South America, the Netherlands, Italy, and Argentina, among other places. It is also described in Indian traditional medical systems such as Ayurveda, Siddha, and Unani. A variety of

phytochemicals were discovered in the plant study (Dhawan *et al*., 2004).The ripened fruits are edible (The Wealth of India 2001).

Some studies have found that plants can help with opiate withdrawal, anxiety, insomnia, attention deficit hyperactivity disorder, and cancer (Akhondzadeh et al., 2001, Reginatto et al., 2006, Wheatley 2005, Ahondzadeh et al., 2001, Ichimura et al., 2006, Rowe et al., 2004, Nassiri-Asl et al., 2007).The purpose of this review is to provide information on the *Passiflora* genus, including morphology, active ingredients, and pharmacognostical and pharmacological properties. These plants have been linked to a variety of pharmacological effects.

Morphology

The *Passiflora* stem is herbaceous and woody. The leaves are alternate, simple and entire during the germination and early stages of growth. Later, they are lobed or palmate, imparipinnate, petiolate, stipulate, and have auxillary tendrils which arise from the sterile pedicels. Flowers are bisexual and have five petals and five sepals alternating with each other. Both petals and sepals are similar in size and colour. The sepals are distinguished by a green hookat at the tip. The large hollow receptacle, like a cup, bears numerous filamentous appendages between the petals and stamens. The conspicuous corona is formed by these brightly coloured appendages. Three to five stamens are inserted at the top of the gynophore; filaments are filiform, free, or monoadelphous, with two-celled anthers that dehisce longitudinally. Carpels 3 to 5 united, stigmas clavate or peltate, superior ovary, unilocular, containing several ovules on parietal placentation. Fruits are single-celled, indehiscent berries, and seeds are numerous. Insect pollination is found in *Passiflora.* For the attraction of insects, the extraordinary corona developments, the strongly scented flowers, and nectar secreted in the receptacle play an important role. Extrafloral nectories are found on the petiole (Dhawan *et al*., 2004). The exotic genus *Passiflora* has different species which are cultivated in gardens for their beautiful ornamental flowers. *P. edulis* (purple passion flower) is the most famous species. It produces the purple or yellow fruits that we commonly call "passionfruit."

Microscopy

Sreelakshmi *et al.* (2014) studied the relationship between the leaf area and the taxonomic importance of foliar stomata of nine different plants. *P. edulis* Sims was one of them. In *Passiflora,* anisocytic and paracytictype stomata were randomly arranged.

Sethi (2019) used scanning electron microscopy to examine the leaf lamina trichomes and discovered unicellular twisted, glandular trichomes with a flat surface and wavy anticlinal epidermal wall cells.

Phytochemical, Nutritional and Antioxidant studies

Ramaiya *et al.* (2019) studied the nutritional and organic acid composition of different species of *Passiflora* fruit juice and mesocarp. In the analysis, they found that all the species of fruit juice have near the same values of nutritional and organic acids. While the mesocarp shows higher fibre content in comparison with its fruit juice, Citric acid and malic acid were the most prevalent organic acids in *Passiflora* fruit juice.

A bromatological and spectroscopic analysis of the leaves of *P. foetida* L. was explored by Odewo *et al.* (2014). *Passiflora* leaves contained a significant amount of basic food nutrients such as protein, fats, carbohydrates, ash, moisture, and fiber.Whereas in phytochemical analysis, ethanol extract of leaves showed saponins, tannins, cardiac glycosides, alkaloids, anthraquinones, steroids, and flavonoids. The authors also carried out an infrared spectroscopy analysis to find out the molecular structure of the sample. In that, they found that the acid functional group (C=O-N) is what makes the unsaturated oil.

Shanmugam *et al.* (2018) analysed the phytochemical, carbohydrate and antioxidant profile of *P. subpeltata*fruit pulp. A total of fifteen polyphenolic compounds were identified using UHPLC-QqQ-MS/MS analysis, which included protocatechuic acid, ferulic acid, vanillic acid, epicatechin, p-coumaric acid, cinnamic acid, eriodictyol, and quercetin-3-glucoside etc. while the fruit showed α-amylase and α –glucosidase inhibition.

Saravanan and Parimelazhagan (2014) investigated the invitro antioxidant, antimicrobial and anti-diabetic activities of different solvent extracts of *P.ligularis* Juss. fruit pulp. Acetone extract determined the greatest amount of total phenolics, tannins, and flavonoids content from the number of solvents used. Acetone extract, on the other hand, demonstrated effective DPPH, ABTS, superoxide and nitric oxide radical scavenging activities, ferric reducing antioxidant capacity, and metal chelating abilities.

The acetone extract of P. ligularis fruits inhibited α--amylase and α-glucosidase enzymes significantly, and the fruits of *P. ligularis* have antibacterial and antifungal characteristics. HPLC analysis revealed the presence of ellagic acid, gallic acid, and rutin in the quantification research.

HPTLC was used by Zeraik et al., 2012 to demonstrate the content of isoorientin in passion fruit rinds. As a result, healthy *P. edulis* rinds had more isoorientin than rinds exhibiting typical indications of passion fruit woodiness virus infection. The radical-

scavenging action of *P. edulis* rinds was discovered using HPTLC, and the rinds were found to be a natural source of flavonoids. The largest quantity of phenolic and flavonoid content was found in the leaves of *P. edulis* during the reproductive stage Guimaraes et al (2020). Lima et al. (2018) discovered that passion fruit flour reduced DPPH levels and inhibited Staphylococcus aureus more effectively.

The antioxidant activity and physicochemical parameters of *P.glandulosa* Cav. pulp from the Cariri region were investigated by Lima-Neto et al. (2017). They discovered that this passion fruit's proximate constituent and caloric value are similar to those of other species. In comparison to other fruits, the pulp of *P. glandulosa* contains more ascorbic acid and fewer polyphenolic substances. Pulp, on the other hand, has a higher titratable acidity and total soluble solids. The antioxidant capacity of extract and fraction of yellow passion fruit (*P.flavicarpa*) leaves was determined by Saptarini et al., 2013. The ethyl acetate fraction had the highest antioxidant activity when compared to the ethanolic extract, n-hexane fraction, ethyl acetate fraction, and water fraction.

P. foetida Linn. Fruit contains a variety of phytochemicals such as carbs, protein, fat, reducing sugar, ascorbic acid, flavonoids, alkaloids, phosphorus, magnesium, calcium, amino acids, cholesterol, and phenolic compounds, according to the researchers. The phytochemical content of *P. edulis, f. flavicarpa* seeds and seed oil was analysed by Silva *et al.* (2015). The study revealed that the passion fruit seeds and their oil are useful in human food and also reduce organic waste in the fruit industry. Passion fruit seeds contain moisture, lipids, proteins, ash, fibers, titratable acidity, pH, soluble solids, and possess antioxidant activity.

The total phenolic content, antibacterial activity, and antioxidant potential of the leaves and stems of *P. quadrangularis*, *P. maliformis*, and *P. edulis* were investigated by Ramaiya et al (2014). The highest antioxidant components were extracted from methanol extracts of *P. edulis* leaves and stems (24.28 percent) and *P. quadrangularis* leaves and stems (24.28 percent) using various solvents (petroleum ether, acetone, and methanol) (9.76 percent). *P. maliformis* leaf methanol extract had the highest TPC concentration and antioxidant potential, while *P. quadrangularis* stem methanol extract had the highest phenolic content and antioxidant activity. In antibacterial research, the methanol extract of *P. maliformis* had the highest inhibitory zone against B. subtilis.

Phytochemicals such as glycosides, alkaloids, saponins, phenolic compounds, carbohydrates, tannins, proteins, amino acids, and triterpenoids are found in the plant *P. foetida* (Biruduet al. 2019).

The ethanol extract of *P. edulis* Sims. demonstrated excellent antioxidant potential, despite the fact that the plant contains a variety of phytochemicals (Sunitha and Devaki 2009). The antioxidant capability of *P. foetida's* various parts (root, leaves, flower, and seed) was assessed by Sasikala et al., (2011). Petroleum ether and ethanol were used to extract the various parts of the plant. Among all the extracts from all components, the fruit peel had the highest antioxidant and antihemolytic characteristics, as well as a high-carotene content.

The phenolic compounds of *P. tripartite* were studied using high performance liquid chromatography linked to a high resolution mass spectrometry detector (HPLC-ESI-TOF-MS) by Giambanelli et al., 2020. In the extracts, they discovered a total of 82 polar chemicals, including phenolic acid derivatives, organic acids, benzophenones, flavan-3-ols, flavonols, and flavones.

The primary flavone identified in passion fruit pulp, *P. edulis fo*. flavicarpa O. Deg., is isoorientin (ZeraikandYariwake, 2010). The fruit pulp of *P. edulis fo.* flavicarpa O. Deg. was used to isolate monoterpenoids (Osorio et al., 2000). Sakalem et al. (2012) investigated the phenolic composition of various *Passiflora* species. Flavones C-glycosides were detected in all extracts using HPLC-DAD-ESI-MS/MS, whereas the predominant ingredients in *P. vitifolia, P. coccinea, P. bahiensis,* and *P. sidifolia* were flavones C-glycosides. All species include apigenin-6-C-rhamnosyl-8-C-arabinoside in addition to flavone-6,8-di-C-glycoside. *P. quadrangularis* has cyclopassiflosides with cyanogenic glycosides, while *P. coccinea* has flavones-C glycosides and procyanidins.

The juices obtained from the pulps of *P. edulis, P. maliformis,* and *P. quadrangularis* were high in fibre, protein, and carbohydrates, as well as minerals such as K, Mg, P, and Fe. Aside from the juice, the edible mesocarp of *P. quadrangularis* is a nutrient-dense food (Ramaiya et al., 2019).

Bioactivity of *Passiflora*

Colomeu et al. (2017) compared the antioxidant and antiproliferative effects of four *Passiflora* species. The aqueous extract of *P.edulis* (yellow) showed stronger phenols and antioxidant activity than the other four Passion fruit species, as well as inhibiting T lymphocytes.

The phytochemical and antibacterial activities of *P. edulis* var. flavicarpa seed extract were investigated by Kanu et al. (2017). In preliminary phytochemical investigation, flavonoids, alkaloids, steroids, and saponins have been found in preliminary phytochemical investigation. The growth of *Staphylococcus aureus, Escherichia coli*, and *Candida albicans* is inhibited at various doses of extracts. Where as, according to Razia et al. (2014) and

Aernan et al. (2016), the extract of *P. edulis* had antibacterial action against the pathogenic microorganisms *Escherichia coli, Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa, Salmonella typhi, Klebsiella pneumoniae,* and *Shigella spp*. Mohanasundari et al. (2007) conducted a similar study on *P.foetida*. The antibacterial efficacy of the ethanolic leaf and fruit extracts against *P. putida, V. cholera, S. flexneri*, and *S. pyogenes* was shown to be varied. Preliminary phytochemical and antibacterial activities of *P. edulis* leaf and callus were discovered by Johnson et al. (2008). The chloroform extract of the leaf and callus had the highest solubility and antibacterial activity among the different solvents tested. The phytochemicals in ethanol and chloroform extracts, on the other hand, were confirmed.

By using the agar method, Wasagu et al. (2016) discovered comparative phytochemical analyses and antibacterial activity of P. edulis fruit rinds, seeds, and juice extract on *Salmonella typhi, Escherichia coli, Staphylococcus aureus*, and *Aspergillus niger*. The antibacterial activity of the rind and seed was significantly higher than that of the other fruit sections. The *Passiflora* species is often used as a sedative, as well as a treatment for irregular fevers and skin inflammation (Zucolottoet al.,2009). *P. incarnata* could be beneficial in the treatment of neuropathic pain (Amanet et al., 2016). In the plant extract of *P.edulis,* the flavonoids vicenin-2, orientin, isoorientin, vitexin, and isovitexin were determined to have analytical content. In mice, extracts of *P. edulis* (50 and 100 mg/kg) as well as extract-loaded nanoparticles (5 mg/kg) have antidepressant action (Alves et al., 2020).

Preclinical studies have revealed that *P. incarnata* has a wide range of pharmacological actions, including anxiolytic, sedative, antitussive, antiasthmatic, and antidiabetic properties. (Miroddi et *al.,* 2013). Deng *et al*. (2010) carried out the neuropharmacological activities of the aerial part of *P. edulis* f. *flavicarpa and* found that the plant has anxiolytic and sedative properties.

The antioxidant activity of methanolic extracts of pulp from *P.edulis* and *P.alataas*, as well as the rind of *P. edulis,* was investigated by Zeraik et al. (2011). The flavonoids were extracted from healthy and diseased passion fruit pulp and rinds with the virus that causes passion fruit woodiness (PWV). Both the pulp and the rind of the fruit play important roles in inflammation.

The analgesic and anti-inflammatory properties of *P. foetida* leaves ethanol extract were discovered by Sasikala et al. (2011). Analgesic and anti-inflammatory activities were found in *P. foetida* leaf extract. Silva et al. (2013) investigated the antioxidant activity of *P. edulis* leaf aqueous extract. They discovered that *P. edulis* leaves are a rich source of bioactive chemicals such as polyphenols using HPLC-PDA and ESI-MS/MS analyses. The antioxidant

activity of aqueous extracts of leaves, as well as SOD, GR, GPx, ORAC, GSH in the kidneys, and thiobarbituric acid reactive compounds in the liver, brain, and kidneys, is high. The presence of asvitexin, isovitexin, and isoorientin in the leaves of *P. edulis* was investigated.

Osma et al. (2013) found antioxidant and antipoliferative properties in *P. edulis* chacked leaf extracts and fruit juice. Cardiotonic glycosides, flavonoids, and tannins were discovered by phytochemical analysis. The leaves had a lot of DPPH activity, while the juice had a lot of hydroxyl free radical-scavenging activity. H_2O_2-induced hemolysis was reduced by 98 percent in both extracts.Aqueous extracts of leaves had the best cytotoxic activity against SW480 and SW620 cells. Based on this study, it appears that *P. edulis* could be a useful source of antioxidants.

Conclusion

According to the information gathered, there are several species of the plant *Passiflora*. Each species has its own set of properties, which can be therapeutic, nutritional, or bioactive. On the other hand, diseased fruits or other fungal, microbial development on fruits or leaves demonstrated a favourable feature, and the plant has a traditional value. Based on the data, it was determined that precise chemical elements from each plant species, as well as *Passiflora* bioprospecting, are required.

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