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Functional Properties of *Physalis Pubescens Linnaeus*: A Literature Review

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Abstract

Physalis pubescens L. has exotic fruit, native to the Americas, with potential to be widely used for consumption. This plant has yellow fruits accompanied by chalices. The aerial parts are used in traditional medicine due to its preventive and curative effect. Its fruits are aromatic and mildly acidic, besides containing compounds that contribute to the functional capacity of the fruit. Due to the health benefits, the use of this plant has generated a great commercial interest. Purpose of this review was to compile information on the functional properties of *Physalis pubescens*, as well as to explore information on some of the major species of *Physalis*.

Keywords: Plant; Fruit; Exotic; Benefits and health.

1. Introduction

Brazil has a great biodiversity of vegetables, where innumerable plants are used by the population in the medicinal or alimentary form. Although there is such diversity, information on the Brazilian flora is still scarce [1]. Studies with species of plants of the genus *Physalis* have been more exploited due to their high herbal potential (P. *peruviana L., P. Alkekengi L., P. Minima L., P. pubescens L. and P. angulata L.*). This plant presents an annual production of fruits, which are destined for nutritional purposes in fresh, jelly, juice or raisins, due to their sensorial and nutritional characteristics, because they have sweet flavor, high content of phenolic compounds, vitamins and minerals [2].

The Solanacea family belongs to unconventional food plants (UFPs), and among them is the genus *Physalis* spp. highlighting *Physalis pubescens*, which is considered a pantropical species, that is, it is present in any region of the tropics. This species is still rare in Rio Grande do Sul / Brazil, even if it is a rustic and easily adapted plant [3] According to Muniz, *et al.* [4] temperate regions where winter is severe can cause the plant to die.

Physalis pubescens grows in humid places, such as clearings, forest edges and near water courses; but also exhibits ruderal behavior, often found along roadsides and in sandy locations [5].

One of the main characteristics of these species is the presence of steroids, called vitaesteroids, which originate from the mevalonic acid pathway, and which arouse great interest in the pharmacological area [6]. Due to its composition, *Physalis* consists of a genus of ethnobotanical, nutraceutical and medicinal value, to which various medicinal properties are attributed [7]. A study by Hassan and Ghoneim [8] evaluated the anti-diabetic effect of *Physalis pubescens* juice in diabetic rats. Zeng, *et al.* [9], evaluated the anti-inflammatory, antibacterial and analgesic properties of extracts of *Physalis pubescens.* The authors [10] evaluated the action of the fruit extracts of *Physalis pubescens* on four renal cell carcinoma cell lines.

Because it is considered an unconventional food plant (UFP), some species of *Physalis* are little known. Thus, this review aimed to compile information on physical and chemical characteristics with emphasis on the bioactive compounds of *Physalis pubescens*, as well as to explore the information of some species of *Physalis.*

2. The Genus Physalis Linnaeus

The genus *Physalis* belongs to the family Solanaceae and has about 100 species, among which are some of agronomic interest that are easily recognized by the inflated chalice, which surrounds and protects the fruit against insects and inclement weather [1, 11]. Most species of *Physalis* present herbaceous or shrub habit, and are distributed by diverse continents of the world, mainly in the tropical and subtropical regions [7, 12]. According to the genus *Physalis* was first described by Linnaeus in 1753, and there have been several studies that refer to this plant. The name *Physalis* comes from the word "physa" which means bubble or bladder and has direct relation with the chalice that contains its fruits [6]

The ripe fruit is a globose berry, about 2 cm in diameter and a large amount of seeds, it has a yellowish to dark orange coloration, a soft and juicy appearance and a sweet and slightly acidic taste. The fruits are covered by the inflated chalice, initially of greenish coloration that during maturation passes to the straw, presenting a paper texture at the ideal collection point [13].

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The fruit has high nutritional value due to the content of vitamins and minerals [14], besides flavonoids, alkaloids,phytosteroids and carotenoids, which are considered bioactive functional properties [15].

Physalis is native to America, being adaptable to the wide variety of soils, both sandy and loamy, and can develop in the shade or semi-shade [16]

In many countries *Physalis* is grown in backyards of residences for direct consumption however, it is important in some international markets, as in Europe, where the price paid for the fruit is high. The fruit is usually consumed in fresh form and in salads, but can also be used in the production of jellies, sweets, ice cream, dairy drinks, yoghurts and liqueurs [2, 17].

In Brazil, *Physalis* is popular in the North and Northeast, but little known in the South and Southeast, where it is already produced on a small scale [18].The fruit of *Physalis* is consumed in Brazil as a fine food, with a high commercial value on average fifty reais per kilo of the fruit. Its commercial cultivation is recent, and has been growing gradually mainly in the South of the Country [1]. The plant can be an excellent alternative for the small and medium rural producers, who can change the position of the country of importer to exporter of the fruit, besides being an alternative for the agribusiness [2].

According to Muniz, *et al.* [4], the plant presented an easy adaptation in Brazil, being characterized as edaphoclimatic, that is, in temperate regions where winter is strict, mainly in higher regions of Santa Catarina and Rio Grande do Sul, the occurrence of frosts can cause death of the plant, becoming an annual cycle crop, causing seasonal production.

The same authors also point out that in subtropical regions, where there is no frost occurrence, the plant adapts at any time of the year, and the crop cycle can extend for up to two years, and after this period, both productivity and the quality of the fruits decrease.

3. Culture Conditions

The first description of the genus *Physalis* was made by Linnaeus. According to the "Plant Database" of the United States Department of Agriculture [19], the taxonomic classification of *Physalis* comprises the Kingdom Plantae: Subkingdom, Tracheobionta; Superdivision: Spermatophyta; division: Magnoliophyta; class: Magnoliopsida; subclass: Asteridae; order: Solanales; family: Solanaceae; and genéro: *Physalis Linnaeus*.

In Brazil, Physalis cultivation began in 1999 at the Santa Luzia Experimental Station in São Paulo / Brazil [20], showing excellent results in soil diversity and spacing. As of 2008, new fruit growers began to cultivate *Physalis*, and this improvement brought good prospects and success for family farming [4].

The first stage of production tends to be the development of seedlings, on which production will depend. In order for this initial process to be efficient it is often necessary to use alternative materials to the soil, whether physical or physiological of the plants being necessary, in some cases the use of substrates [21]. When conditioned in limited space (in the case of pots or polyethylene bags) substrates, as well as soil, influence the root system and the biological associations of the seedlings with the environment, being primarily related to nutrition and translocation of water in the plant- atmosphere [22].

The most common ways to propagate *Physalis* are by sex, using seeds, and by the asexual route, when using different methods and parts of the plant [23]. There are several methods to define the most appropriate time for harvesting, however, chalice staining is most commonly used by farmers Cedeño and Montenegro [24].

4. Main Species

4.1. *Physalis alkekengi L.*

Physalis alkekengi (Figure 1) , also popularly known as the cherry bladder, Chinese lantern, Japanese lantern, winter cherry or even as hozuki, is native to eastern Asia in southern Japan and differs from other species by bright orange of the capsule surrounding the fruit [25-27].

It is a perennial herbaceous plant that grows from 40 to 60 cm in height, being popularly used as an ornamental plant. It has medicinal uses with some restrictions, since inappropriate use can cause side effects, such as abdominal pain and abortion [28].

It has berries about 17 mm in diameter, where each fruit is covered by a protective capsule against parasites and other external agents. The chalice is toxic and therefore should not be ingested, but has been used in traditional Chinese medicine as a therapeutic agent [29]. Homeopathic remedies are also produced from the fruit, being used in the treatment of kidney and bladder disorders [22].

Gallen, *et al.* [30] report a case where a severe anaphylactic reaction with edema and drop in blood pressure was observed in a nine-year-old girl after consumption of a single Japanese cherry fruit (*Physalis alkekengi*), and the possible explanation is the presence of termite allergens in seeds of the fruits.

Figure-1. Plant, flower and fruit of *Physalis alkekengi*

Source: Rufato, *et al.* [23]

4.2. *Physalis ixocarpa L.*

Known as Mexican tomato, it is widely cultivated throughout the Western Hemisphere (Figure 2). It is native to Mexico, where different types and varieties are grown, differ in berry size, color (green and purple) and flavor [31].

The plant has long stems that can reach three meters in height, adapts to mild to dry climates, and produces spherical fruit of green coloration [2].

The fruit has a green coloration, slightly sour and sweet flavor, with a citric touch. It is widely used as an ingredient for Mexican table sauces known as green parsley (green sauce). The ripe fruit can be eaten raw, in the form of raisins, in desserts, as an aperitif or in the decoration of dishes. The fruits contain high content of vitamin A, B, B2 and C, and of polyphenols [32, 33].

According to Medina-Medrano, *et al.* [34] and González-Mendoza, *et al.* [32] scientific studies have pointed out the importance of the compounds promoting the health of *Physalis ixocarpa L.* in relation to its high content of antioxidants.

Figure-2. Plant, flower and fruit of *Physalis ixocarpa*

Source: Rufato, *et al.* [23]

4.3. *Physalis angulata L.*

Known as camapu or balloon, it presents a branched shrub with ruderal behavior, and is frequently found in cropped soils in the period prior to planting, which can reach 40-70 cm in height [5]. Its reproduction occurs through seeds, grows spontaneously in the form of small populations, and presents annual cycle. By this characteristic it is considered a weed, infesting agricultural crops and vacant lands [35].

The fruit (figure 3) is climacteric of the fleshy berry type of yellow / greenish color, with a diameter between 1.0 and 1.5 cm, containing small and numerous seeds, and contains several compounds of phenolic nature [36].

Figure-3. Flower and fruit of *Physalis angulata*

Source: INPN; **Photo:** C. Delnatte

4.4. *Physalis peruviana L.*

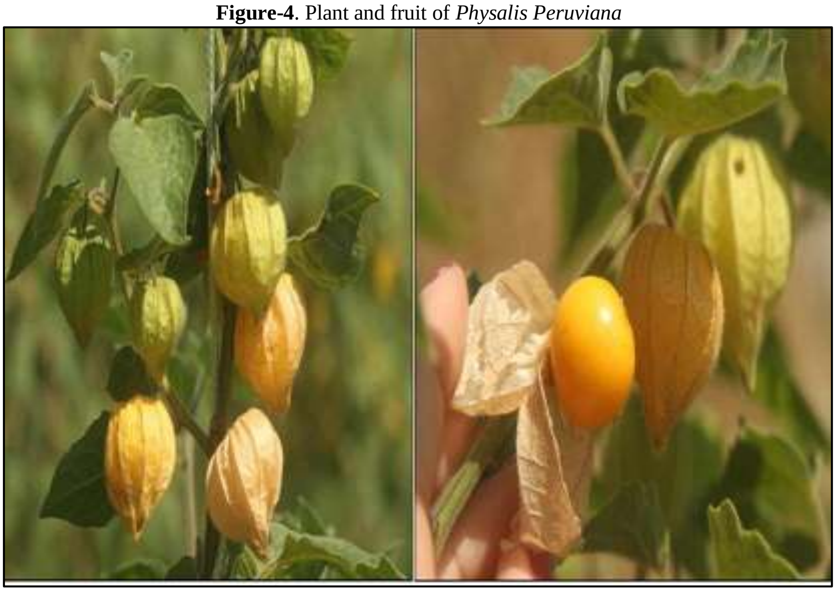
This is the most well-known species of the genus *Physalis*, with Andean origin [37], and is currently cultivated commercially in several tropical and subtropical countries [38]. É uma planta arbustiva, herbácea e perene, considerada como anual em plantações comerciais.

Physalis peruviana L. is known as goldenberry in English-speaking countries, uchuva in Colombia, caipira in South Africa, uvilla in Ecuador, ras bhari in India, aguaymanto in Peru, and as topotopo in Venezuela [39].

The fruit (figure 4) has an ovoid orange-yellow color, 1.25 to 2.50 cm in diameter, and 4 to 10 g in weight. The fruit contains about 100 to 200 small seeds and is protected by the chalice [40].

According to Puente, *et al.* [41] the fruits are known for their characteristic sensorial properties of taste, odor and color, and for the nutritional value due to the content of vitamins A and C, potassium, phosphorus and calcium. The fruits are marketed in fresh form, as confectionery, or in the form of jellies or sweets in bulk [42].

Figure-4. Plant and fruit of *Physalis Peruviana*



Source: Embrapa Vegetables; **Photos**: Rodrigues [42]

5. *Physalis pubescens L.*

Considered as an unconventional food plant, *Physalis pubecens L.* is native to the North and Northeast regions [35, 43] is popularly known as fisalis, joá de capote, bode bag, camapu, curuputi, frogfish; "Hosuki" (in Japan) and "tomatillo" (in Spain) [44]. Chen, *et al.* [45] and Chiang, *et al.* [46] report that roots, stems and leaves are used in traditional medicine, mainly as antipyretics, diuretics, antitumorals, analgesics and anti inflammatories.

This shrub, annual, can reach up to 1 m in height if properly monitored. It has green, angular and hyaline branches with the presence of short and long trichomes distributed throughout the plant surface. The diameter of the leaves is variable, they are isolated, of membranous aspect, with cut edges, pubescent along the ribs. It presents a petiole of 1.0 to 10 cm in length, flowers with 0.3 to 1.2 cm in length and floriferous chalice with 0.3 to 0.6 cm in length. When ripe, the fruit measures 1.0 to 1.5 cm in diameter [47].

de Carvalho Soares, *et al.* [47], and coworkers report two peaks of flowering, the first from February to April and the second in July, and two peaks of fruiting, one from November to December and another from April to July. According to Hunziker [48]. He fruits are edible and *Physalis pubescens* resembles *Physalis peruviana*, from which it differs as to the habit, indument and morphology of the fruiting chalice.

The ripe fruit (Figure 5) is a globular, yellow / greenish berry, with a sweet and juicy aspect, with a sweet, slightly acidic flavor and with a large amount of seeds [13]. The fruit is covered by the inflated chalice which, in addition to protecting the fruit against insects, birds, pathogens and adverse climatic conditions, also serves as a source of carbohydrates during the first twenty days of fruit development [37].

Figure-5. Plant, Chalice and Fruit of *Physalis pubescens*

Source: author

Its flowers (Figure 6) are small, hermaphrodite, yellowish in color with brown spots on the base [13].

Figure-6. *Physalis pubescens* plant and flower

Source: author

5.1. Morphology of *Physalis Pubescens L.*

da Silva, *et al.* [1], report the anatomical aspects of the stem of *Physalis pubescens*, which has an angular shape, trichomes with bicellular eglandular tectors, symmodial branching, vascularization with bicolateral vascular cylinder, epidermis of tabular type and angular colenquimm.

Alamino [49], reports that the leaf blade of *Physalis pubescens L*. is hypoestomatic, that is, it presents stomata located in the lower epidermis of the leaf, in addition to a large number of druses (crystals composed of calcium oxalate in the form of a needle usually found fixed to the cell wall) within the lacunar parenchyma. Its stomata are divided into anisocytes (it has three subsidiary cells of different sizes that circulate the stomata) and anomocytic (no subsidiary cells). The plant presents a large number of simple trichomes (Figure 7), glandular and eglandular dispersed throughout its length.

Figure-7. Simple trichomes in *Physalis pubescens*

Source: author

The same author reports the presence of secretory structures, as is the case of trichomes, which may be a great indication of the presence of secondary metabolites in the plant as essential oil. The absence of stomata on the adaxial side (upper part) of the leaves of *Physalis pubescens* was also observed, which may be useful in elucidating and establishing possible differences among species of the genus.

The stem morphology of *Physalis angulata*, *Physalis peruviana* and *Physalis pubescens* resemble, in a general way, where all species present the epidermis of the uniseriate stem, although the epidermal cells of *Physalis pubescens* are more elongated than those of the other two species [1].

Physalis pubescens presents thick and bulky angular collenchyma, which can be explained by the storage capacity of defense substances as the secondary metabolites [1].

5.2. Physicochemical and Bioactive Composition of *Physalis Pubescens L.*

As for the physicochemical characteristics (Table 1), the fruit has a low pH, which favors the stabilization of ascorbic acid against oxidation processes, thermal treatments and exposure to radiation [2].

The fruit contains a small amount of oil, around $1.1 g.100g^{-1}$, has a high proportion of unsaturated fatty acids (65.5%), including 32.5% polyunsaturated fatty acids and about $13.4 g.100g^{-1}$ protein, which can be considered a good source essential amino acids. In addition, the fruit contains high content of phenolic compounds, carotenoids, and all minerals important for the maintenance of the human body: copper, boron, phosphorus, manganese, zinc, potassium, iron and calcium.

In Table 1 it is possible to visualize some studies of the physical chemical composition of *Physalis pubescens L.*

Table-1. Physical chemical composition of *Physalis pubescens L*, according to the literature

Parameters evaluated	Reference
Fruit: Total solids; 18.65%; Total soluble solids: 13.46%; pH: 3.74; Titratable total acidity in citric acid: 1.23%; Sugar / acid ratio: 11.27 / 1%; Proteins: 2.46%; Reducing sugars: 2.19%; Non-reducing sugars: 1.72%; Total Sugars: 3.91%. Juice: total solids: 10.87%; Total soluble solids: 10.65%; pH: 3.54; Titratable acidity in citric acid: 1.43%; Sugar / acid ratio: 7.59 / 1; Proteins 1.02%; Reducing sugars 1.53%; Non-reducing sugars 0,82%; Total Sugars 2.35%. The evaluated parameters were expressed in wet matter.	[16].
The evaluated parameters were expressed in wet matter. pH: 3.54; Total titratable acidity: 1.43% (in citric acid); Total soluble solids: 10.7%; total solids: 10.9%; total sugars: 6.95%; ashes: 7.01%; proteins: 1.02%; lipids: 0.13%; pectin: 0.14%; essential amino acids: 31.799g / 100g protein; non-essential amino acids: 68.20g / 100g protein; (mg / 100 mL), calcium (70 mg / 100 mL), sodium (35 mg / 100 mL), magnesium (19 mg / 100 mL), zinc (2 mg / 100 mL), potassium (1,196 mg / 100 mL), phosphorus , Iron (1.2 mg / 100 mL) and manganese (0.6 mg / 100 mL).	El Sheikha, *et al.* [50]; El Sheikha, *et al.* [51]
Soluble solids ranged from 7.67 to 10.50%; antioxidant activity ranged from 0.66 to 2.65% citric acid; SS / AT ratio ranged from 2.90 to 15.97; pH ranged from 3.19 to 4.64; Total soluble sugars varied from 1.05 to $7.46 g.100g^{-1}$. The evaluated parameters were expressed in wet matter.	Silva [11]
Soluble solids: 9.65 ° Brix; total sugars: 9.6%; titratable acidity: 0,9%; pH: 4.72. The evaluated parameters were expressed in wet matter.	Мамедов, *et al.* [52].

Because it is considered a tropical fruit, *Physalis pubescens* plays an important role in nutrition, besides being sensorially attractive based on its color, taste, texture, odor, homogeneity and general appearance Silva [11].

In a usual diet, besides containing macro and essential micronutrients, it should provide some chemical compounds that participate in specific biological activities, which in great majority are found in fruit and vegetables Silva [11]. In addition, epidemiological studies emphasize that diets rich in plant foods contribute to the prevention of various diseases, including cardiovascular diseases, metabolic disorders, neurodegenerative and inflammatory diseases.

Bioactive or phytochemical compounds are molecules that exert a beneficial effect on living organisms, tissues or cells. These are present in a wide variety of foods (fruits, vegetables, wild plants, among others), and their intake provides improved organism functioning, with regard to the prevention and / or treatment of various diseases [53].

Most of the bioactive compounds present in plants are effectively produced as secondary metabolites. Several compounds with bioactive potential present in plants, such as vitamins, carotenoids (carotenes and xanthophylls) and polyphenols [54].

In Table 2 it is possible to visualize some studies of the bioactive composition of *Physalis pubescens L.*

Table-2. Bioactive composition of *Physalis pubescens L*, according to the literature

Part of the plant	Constituents evaluated	Reference
Fruits and juice	Fruit: Carotenoids (µg / g sample): 69.55; polyphenols in tannic acid (mg / 100 g): 82.00; ascorbic acid (mg / 100g): 39.68. Juice: carotenoids (µg / g sample): 70.01; polyphenols in tannic acid (mg / 100 g): 76.62; ascorbic acid (mg / 100g): 38.77	El Sheikha, *et al.* [16].
Juice	Carotenoids (µg / mL): 70; polyphenols (mg / 100 mL): 76.6; ascorbic acid (mg / 100 mL): 38.77. Phenolic compounds: Protocatecuic acid: 0.932 µg / 100 mL; parahydroxybenzoic acid: 0.561 µg / 100 mL; chlorogenic acid: 2.086 µg / 100 mL; catechin: 4.998 µg / 100 ml; phenol: 15.605 µg / 100 mL; vanillic acid: 2.727 µg / 100 mL; para-coumaric acid: 5.368 µg / 100 mL; ferulic acid: 10.036 µg / 100 mL; salicylic acid: 7.341 µg / 100 mL; routine: 0.449 µg / 100 mL; cumaric acid: 0.176 µg / 100 mL; myricetin: 0.104 µg / 100 mL.	El Sheikha, *et al.* [50]; El Sheikha, *et al.* [51]
Fruits	Antioxidant Activity by DPPH Radical: 60% EtOH Fraction (EC 50 = 2.58 µg / mL); 30% EtOH fraction (EC 50 = 1.95 µg / mL); 90% EtOH fraction (EC 50 = 18.74 µg / mL); Aqueous fraction (EC 50 = 33.71 µg / ml). Calceolariaside,quercetin-3-O-β-D-glucopyranoside, caffeic acid and 1- O -cafeoyl-β-D-glucopyranoside, EC 50 values in the range of 0.51 to 1.86 µM.	Deng, *et al.* [55].
Fruits	Ascorbic acid: 9.9mg / 100g; polyphenols: 318mg.EAG / 100g. Constituents analyzed in dry matter.	[52].
Fruits and juice	Carotenoids in fruits: 1.28-1.38 mg / 100 g; Carotenoids in calyces: 153-306 µg / g.	[56].
Leaves and fruits	Phenolic compounds identified and quantified by HPLC-DAD / HPLC-DAD. Leaves: Gallic acid: 0.19mg / g; chlorogenic acid: 1.68mg / g; p-coumaric acid: 2.35mg / g; ellagic acid: 0.21 mg / g; catechin: 4.73mg / g; rutin: 0.26 mg / g and kaempferol: 1.59 mg / g. Fruits: chlorogenic acid: 1.75mg / g; p-coumaric acid: 4.32mg / g; ellagic acid: 0.69mg / g, catechin: 5.23mg / g and kaempferol: 4.28mg / g.	[57].

5.3. Pharmacological and Medicinal Composition of *Physalis pubescens L.*

The use of plants and fruits for medicinal and pharmaceutical purposes is justified by the presence of complex combinations of secondary metabolites that play an important role in the adaptation of species to their environments, increasing the probability of their survival, with several biological defense properties, such as antimicrobial and antitumor activity [58].

The fruits, roots, stems and leaves are used in traditional medicine mainly as antipyretic agents, diuretics, antitumorals, analgesics and anti-inflammatories [45, 46]. Zhang and Tong [59] the application of different species of *Physalis* in the pharmacological area, exploring the antitumor, anti-inflammatory, antimicrobial, antimalarial, antioxidant and antileishmanial activity.

Antioxidants are substances that retard, prevent or remove oxidative damage, and also the ability to capture oxygen reactive species, acting indirectly in the regulation of antioxidant defenses or inhibiting the production of free radicals [60]. Since natural antioxidants from plants can act through various mechanisms, it becomes important to realize their relationship with different bioativities, where a large part of the natural antioxidants are tocopherols, vitamin C, carotenoids and phenolic compounds, which exhibit power antioxidant, but also anti-tumor, anti-inflammatory, antiviral, among others [54]. These compounds are able to remove reactive oxygen species formed in cells and thus protect the body from diseases [61].

The presence of phenolic compounds in fruits and vegetables is also associated with antimicrobial activity. According to some authors, this antimicrobial potential is related to the high content of flavonoids and condensed tannins present in some species [62].

The antimicrobial activity has already been studied in a large variety of plants, which have been shown to be effective phenolic compounds against pathogenic microorganisms [63]. Application of natural antimicrobials for use as preservatives, especially in the food industry, has received increasing attention due to the growing concern of consumers to consume more natural products [64].

A study by Patel, *et al.* [65] and colleagues evaluated the antimicrobial potential of minimum *Physalis* berries against Gram positive and Gram negative bacteria and concluded that the minimum inhibitory concentration found was 100 µg in both extracts and that the polar compounds present in the crude extract are responsible for the antimicrobial action. In addition, about 60% of the drugs that are used in the treatment of cancer come from natural compounds or derivatives thereof, making these compounds bioactive, increasingly interesting for the pharmaceutical industry [66].

The genus *Physalis* is distinguished by the production of various substances of the secondary metabolism of plants, such as alkaloids, flavonoids, triterpenes and steroids, all with broad pharmacological and medicinal potential. Among these, the most important are the vita steroids, which act on the immune system, mainly due to the action of fisalinas, which are found in the leaves, roots and stems of the plant, in the range of 30 to 500 parts per million (ppm) [35, 67].

Vita-steroids are substances derived from ergostane, polyoxigenic constituents present predominantly in the species of Solanaceae [6], have several substances in its composition, the most important being vitafisaline, which operate in the human immune system and has anti-inflammatory, antiviral and antipyretic, in addition, it has the power to reduce glycemic indexes and cholesterol [2].

Publications of some authors point to some species of Physalis as source of substances derived from ergostan, which were active in the responses to biological tests performed [6, 68, 69].These chemical constituents are considered to be responsible for the immunomodulatory activities [70, 71], antimicrobial [72, 73], anticancer agents [74] among others, thus demonstrating the importance of the Solanaceae family species.

Among ten species of the genus Physalis that contain fisalinas, it was possible to identify nineteen classes of this substance, such as the B, D, F and G fisalins [6, 35, 67]. Fisalinas B, F and G present potent immunosuppressive activity of macrophages and inhibitors in the death induced by liposaccharides, besides inhibiting in vitro the activity of splenocytes and the rejection to halogen transplantation *in vivo*. Assays demonstrate that Fisalin D exhibits an antibacterial activity and stimulate the production of neural stem cells. The fisalinas also demonstrate potential for the fight against neglected diseases. The fisalinas B and D present antimalarial activity, and the Fisalinas B, F and G present leishmanicidal action [70-72, 75-78].

In Table 3 it is possible to visualize some studies on the pharmacological and medicinal effect of *Physalis pubescens L.*

Table-3. Pharmacological and medicinal effects of *Physalis pubescens L*., according to the literature

Part of the plant	Effects reported	Reference
Pulp, skins and seeds	There was a significant effect on the cellular immunity of the mice, that is, the regulatory effect on the T lymphocytes of mice.	Wang, *et al.* [79]
Fruit juice	The results suggest that Physalis can be considered as a potential candidate for the development of a new antidiabetic agent. It offers promising anti-diabetic effects that can be mainly attributed to its potent antioxidant potential. This is the first study done on the possibility of using the juice of Physalis pubescens as an inhibitory effect on diabetes in mice through its impact of free radicals on the beta cells of the pancreas.	Hassan and Ghoneim [8].
Fruits	Steroids demonstrated growth inhibitory effects against four human renal cell carcinoma (RCC) cell lines.	Chen, *et al.* [10].
Fruits and Chalices	The extracts demonstrated positive biological responses on the Malhavu hepatoma cell line, accompanied by the production and reduction of free radicals, and anti-hepatoma drug development.	Wang, *et al.* [80].
Sheets	The extract of Physalis pubescens showed antitumor activity in HeLa cells.	Zeng, *et al.* [9]

6. Conclusion

In this review it was possible to explore information about the characteristics of some species of *Physalis*, with emphasis on *Physalis pubescens*, where physical, nutritional, bioactive and biological properties were approached.

The information described in this review show the importance of the characterization and identification of the compounds present in *Physalis pubescens*, allowing further studies on the action of these substances in health promotion, as well as their technological use in both food and pharmaceutical industries.

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