Prosopis Plant

Subjects: Biology

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Members of the Prosopis genus are native to America, Africa and Asia, and have long been used in traditional medicine. The Prosopis species most commonly used for medicinal purposes are P. africana, P. alba, P. cineraria, P. farcta, P. glandulosa, P. juliflora, P. nigra, P. ruscifolia and P. spicigera, which are highly effective in asthma, birth/postpartum pains, callouses, conjunctivitis, diabetes, diarrhea, expectorant, fever, flu, lactation, liver infection, malaria, otitis, pains, pediculosis, rheumatism, scabies, skin inflammations, spasm, stomach ache, bladder and pancreas stone removal. Flour, syrup, and beverages from Prosopis pods have also been potentially used for foods and food supplement formulation in many regions of the world. In addition, various in vitro and in vivo studies have revealed interesting antiplasmodial, antipyretic, anti-inflammatory, antimicrobial, anticancer, antidiabetic and wound healing effects. The phytochemical composition of Prosopis plants, namely their content of C-glycosyl flavones (such as schaftoside, isoschaftoside, vicenin II, vitexin and isovitexin) has been increasingly correlated with the observed biological effects.

Keywords: Prosopis ; vitexin ; C-glycosyl flavones ; food preservative ; antiplasmodial ; wound healing potential

1. Introduction

Medicinal plants have been used since the beginning of human civilization to treat various diseases. Different properties have been discovered for each plant, due to many researchers' focus on plants as a natural resource for treating human health [1][2]. Of the various medicinal plants, species belonging to the *Prosopis* genus have been widely used in folk medicine. The *Prosopis* genus belongs to the Fabaceae or Leguminosae family, and includes about 45 species of spiny trees and shrubs. This genus is found in both subtropical and tropical areas of the world. Briefly, species belonging to the *Prosopis* genus have been traditionally used for the treatment of asthma, birth/postpartum pains, callouses, conjunctivitis, diabetes, diarrhea, expectorant, fever, flu, lactation, liver infection, malaria, otitis, pains, pediculosis, rheumatism, scabies, skin inflammations, spasm, stomach ache, removal of bladder and pancreas stones, among other applications [3][4][5]. On the other hand, in addition to being being used for centuries for medicinal purposes *Prosopis* plants are also of commercial interest. The paste, gum, and leaves and pods smoke of *Prosopis* plants possess various bioactive properties, such as anticancer, antidiabetic, anti-inflammatory, antimicrobial and antioxidant effects [6][7][8]. These effects have been increasingly correlated with their content in phytoconstituents, namely flavonoids, tannins, alkaloids, quinones and phenolics. Indeed, *Prosopis* plants have been reported as a rich source of phenolic compounds, being anthocyanins and the flavonoids apigenin, luteolin, quercetin and their derivatives the most abundant ones [9][10][11].

Thus, and given the above highlighted aspects, the aim of this review is to provide an in-depth overview of the literature data on the biological activities of the *Prosopis* genus, and to present its potential benefits and applications in both the pharmaceutical and food industries.

2. *Prosopis* Plants Phytochemical Composition

Epidemiological studies have suggested an inverse association between the consumption of phytochemicals (such as carotenoids and phenolics) and a reduced risk of certain diseases, namely chronic disorders [12]. Medicinal plants, and specifically *Prosopis* plants, are rich sources of phytochemicals, among them alkaloids, phenolic compounds, particularly flavonoids (**Figure 1**; **Figure 2**) and phenolic acids (**Figure 3**), glycosides, steroids, tannins and triterpenoids, increasingly recognized as having positive health effects.

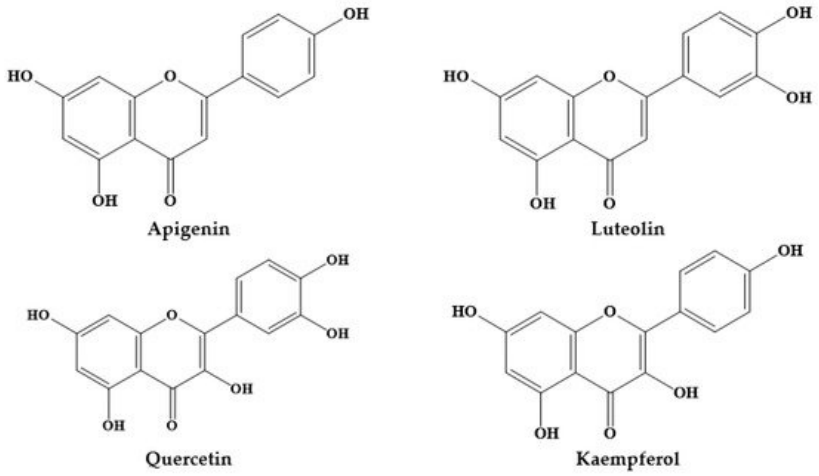

Figure 1. Structures of the main flavonoids in *Prosopis* plants.

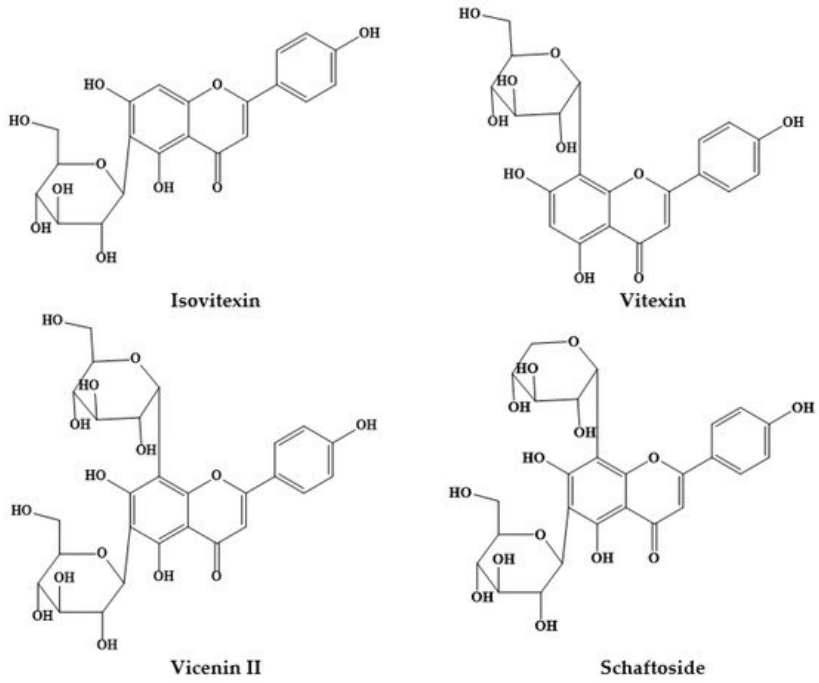

Figure 2. Structures of some C- glycosyl flavones from *Prosopis* plants.

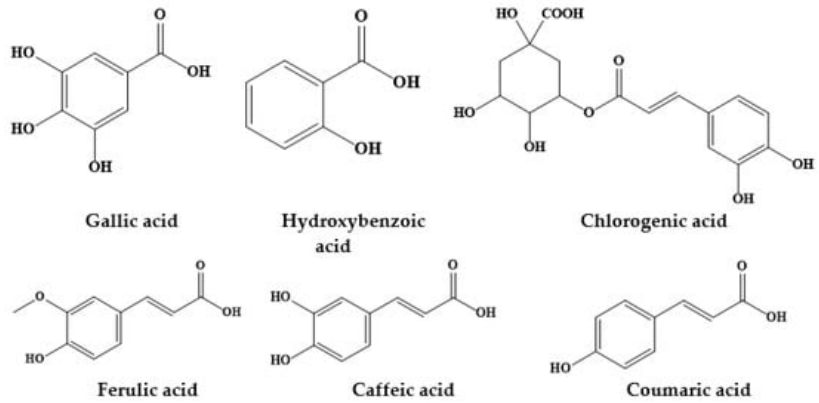

Figure 3. Chemical structures of some phenolic acids from *Prosopis* plants.

Several studies have been conducted to identify and quantify the chemical composition of *Prosopis* plants. The most commonly studied plants and their abundance in phytochemicals are listed in **Table 1**.

Table 1. Identification/quantification of phytochemicals in *Prosopis* species.

Prosopis Plant and Part	Identified/Quantified Phytochemicals	References
P. alba flours	Isovitexin (1.12–0.48 µg/mg) Vicenin II (1.07–0.34 µg/mg) Vitexin (0.91–0.47 µg/mg) Schaftoside (0.42–0.00 µg/mg) Ferulic acid (4.01–0.28 µg/mg) Coumaric acid (3.94–0.33 µg/mg)	[9]
P. alba pods	Q-dihexoside rhamnoside Q-dihexoside Q-methylether dihexoside Vitexin Q-rhamnoside hexoside Isovitexin Q-hexoside K-hexoside	[10]
P. alba flour	Isoschaftoside hexoside (2.43 mg/g) Schaftoside hexoside (3.33 mg/g) Vicenin II/Isomer (0.67 mg/g) Vicenin II/Isomer (2.34 mg/g) Isoschaftoside (23.67 mg/g) Schaftoside (14.86 mg/g) Vitexin (0.46 mg/g) Isovitexin (2.09 mg/g)	[13]
P. alba exudate gum	Ferulic acid 4-glucuronide (E) Apigetrin, chrysin (E) Chlorogenic acid (E and NE) 3-O-feruloylquinic acid (E) p-Coumaroylquinic acid (E) Valoneic acid dilactone (E) Digallic acid (E) Ferulic acid (NE) Esculetin derivative (NE) 7-O-Methylapigenin (NE)	[11]

Prosopis Plant and Part	Identified/Quantified Phytochemicals	References
P. nigra pods	Cyanidin rhamnosyl hexoside Cyanidin-3-hexoside Peonidin-3-hexoside Malvidin dihexoside Cyanidin malonoyl hexoside Petunidin-3-hexoside Malvidin rhamnosyl hexoside Malvidin-3-hexoside Vicenin II Q-dihexoside rhamnoside Isoschaftoside Q-dihexoside Schaftoside Q-hexoside rhamnose K-hexoside rhamnoside Isovitexin Q-hexoside K-hexoside Apigenin hexoside rhamnoside Q methyl ether hexoside rhamnoside K-methyl ether hexoside rhamnoside	[10]
P. nigra flour	Vicenin II (0.34 µg/mg) Schaftoside (0.24 µg/mg) Isoschaftoside (0.27 µg/mg) Isovitexin (0.81 µg/mg) Protocatechuic acid (0.33 µg/mg) Coumaric acid (8.16 µg/mg) Ferulic acid (4.47 µg/mg)	[14]
P. cineraria	Protocatechuic acid (31.65 mg/g) Chlorogenic acid (22.31 mg/g) Caffeic acid (6.02 mg/g) Ferulic acid (9.24 mg/g) Prosogerin A, B, C and D β-sitosterol Hentriacontane Rutin Gallic acid Patulitrin Luteolin Spicigerin	[15][16][17]

Prosopis Plant and Part	Identified/Quantified Phytochemicals	References
P. laevigata	Gallic acid (8–25 mg/100 g) Coumaric acid (335–635 mg/100 g) Catechin (162.5 mg/100g) Gallocatechin (340–648 mg/100 g) Epicatechin gallate (10–71 mg/100 g) Rutin (222.4–256.1 mg/100 g) Morin (236.5 mg/100 g) Naringenin (20 mg/100 g) Luteolin (13 mg/100 g) 4′-*O*-Methylgallocatechin (+)-catechins (-)-mesquitol	[18]
P. juliflora	Apigenin Luteolin Apigenin-6,8-di-C-glycoside Chrysoeriol 7-*O*-glucoside Luteolin 7-*O*-glucoside Kaempferol 3-*O*-methyl ether Quercitin 3-*O*-methyl ether Isoharmentin 3-*O*-glucoside Isoharmentin 3-*O*-rutinoside Quercitin 3-*O*-rutinoside Quercitin 3-*O*-diglycoside	[19][20]
P. glandulosa	Gallic acid (8.203 mg/g) Hydroxybenzoic acid (1.797 mg/g) Pyrocatechol (5.538 mg/g) Caffeic acid (0.295 mg/g) Ferulic acid (0.466 mg/g) Quercetin (0.045 mg/g)	[21]

3. Traditional Medicinal Uses of *Prosopis* Plants

Recent ethnopharmacological studies have shown that *P. africana*, *P. alba*, *P. cineraria*, *P. farcta*, *P. glandulosa*, *P. juliflora*, *P. nigra*, *P. ruscifolia* and *P. spicigera* are amongst the most commonly used *Prosopis* plants in folk medicine treatments. As shown in **Table 2**, different *Prosopis* plants parts are used in diverse regions of the world for the treatment of various diseases. In particular, the positive health effects of *P. cineraria*, *P. juliflora* and *P. africana* have been well-documented [3][4][5][13][14][15][16][17][18][19][20][21][22].

Table 2. *Prosopis* plants traditionally used in the treatment of various diseases in diverse regions of the world.

Scientific Name	Location	Local Name	Parts Used	Administration	Disease(s) Treated/Bioactive Effects	References
	Sélingué subdistrict, Mali	Guele	Bark trunk	Oral, Bath	Malaria	[19]
P. africana	Guinea-Bissau	Tentera, Buiengué, Bussagan, Coquengue karbon, Késeg-késeg, Paucarvão, Pócarvão, Pó-de-carbom, Po-di-carvom, Tchelem, Tchalem-ai, tchela, Tchelangadje, Tchelem, Bal-tencali, Culengô, Culim-ô, Djandjam-ô, Quéssem-quéssem, Djeiha, Ogea	Leaves, bark, roots	Unspecified	Pains, pregnancy (childbirth, breastfeeding, diseases of the newborn), skin inflammations (wounds, burns)	[20]
	Nsukka Local Government Area, South-eastern Nigeria	Ugba	Leaf	Oral	Malaria	[21]
	North-West Nigeria	Kirya, Ko-hi	Roots	Oral	Analgesic, anti-inflammatory	[22]
P. alba	Wichí people of Salta province, Argentina	Jwaayukw, Algarrobo blanco	Resin	Oral	Conjunctivitis, post-abortion pain	[23]
	Bahawalnagar, Punjab, Pakistan	Drucey	Leaves, stem	Oral	Spasm, diabetes, liver infection, diarrhea, removal of bladder and pancreas stone, fever, flu	[5]
				Topical	Rheumatism	
	Thar Desert (Sindh), Pakistan	Gujjo	Fruit	Oral	Tonic for body, leucorrhea	[13]
	South of Kerman, Iran	Kahour	Fruit	Topical	Asthma, skin rash	[14]
P. cineraria	Pakistan	Unspecified	Flower	Oral	Rheumatism	[15]
	Hafizabad district, Punjab, Pakistan	Jhand	Leaf, bark, stem, flower, fruit	Oral, topical, eye drop	Liver tonic, boils and blisters, scorpion bite, pancreatic stone, leucorrhoea, chronic dysentery, cataract	[3]
	Pakistan	Unspecified	Fruit, pods	Unspecified	Asthma	[4]
	Pakistan	Jandi, Kanda, Kandee, Jhand	Leaves, Bark, Flowers, Pods and wood	Oral	Menstrual disorders, contraceptive, prevention of abortion	[16]
P. farcta	Jahrom, Iran	Kourak	Fruit	Oral	Constipation, febrifuge	[24]

Scientific Name	Location	Local Name	Parts Used	Administration	Disease(s) Treated/Bioactive Effects	References
P. glandulosa Torr	Bustamante, Nuevo León, Mexico	Mezquite	Inflorescences	Oral	Stomach pain	[25]
P. juliflora	Thar Desert (Sindh), Pakistan	Devi	Leaves, Gum	Oral	Painkiller, boils opening, eye inflammation, body tonic, muscular pain	[13]
	Hafizabad district, Punjab, Pakistan	Mosquit pod	Whole plant, Flower, Stem, Leaves, Bark	Oral, topical, and as toothbrush	Galactagogue, kidney stones, toothache, breast cancer, asthma, boils	[3]
	Pakistan	Unspecified	Xerophytic shrub	Unspecified	Asthma, cough	[4]
	Mohmand Agency, FATA, Pakistan	Kikrye	Leaves	Oral	Lactation, expectorant	[17]
	Western Madhya Pradesh, India	Reuja	Stem bark	Oral	Asthma	[18]
P. nigra	Wichí people of Salta province, Argentina	Wosochukw, Algarrobo negro	Resin	Oral	Ocular trauma, conjunctivitis	[23]
P. ruscifolia	Wichí people of Salta province, Argentina	Atek, Vinal	Leaves	Oral	Conjunctivitis, stomachache, pimples/rash, scabies, callouses, fever, birth/postpartum pains, diarrhoea, pediculosis, otitis	[23]
P. spicigera	Pakistan	Unspecified	Bark, leaves, flowers	Unspecified	Asthma	[4]

3.1. Prosopis cineraria

P. cineraria is traditionally used as a medicine in different regions of Pakistan, including Bahawalnagar in Punjab Province, the Thar Desert (Sindh) and Hafizabad district in Punjab (**Table 2**). The oral or topical administration of *P. cineraria* leaves, stems, fruits, flowers, barks and pods is used for the treatment of spasms, diabetes, liver infection, diarrhea, bladder and pancreas stones, fever, flu, rheumatism, leucorrhea, boils, blisters, scorpion bite, chronic dysentery, cataract, asthma, sexually-transmitted infections, and gynecological complaints, including menstrual disorders, as contraceptive and to prevent abortion [3][4][5][13][15][16]. Besides Pakistan, in the South of Kerman in Iran, *P. cineraria* flowers are also topically applied to treat asthma and skin rashes [14].

3.2. Prosopis juliflora

P. juliflora is commonly used in Pakistan, and can be either orally consumed or topically applied. Leaves, gum, whole plant, flower, stem and bark of *P. juliflora* are used as a painkiller, body tonic, galactagogue, and expectorant, or to treat boils, eye inflammation, muscular pain, kidney stones, toothache, breast cancer, asthma and cough in Thar Desert (Sindh), Bahawalnagar in Punjab province and Mohmand Agency of Federally Administered Tribal Areas (FATA) [3][4][13][17]. In addition to Pakistan, the stem bark of *P. juliflora* is also consumed in western Madhya Pradesh, India for the treatment of asthma [18].

3.3. Prosopis africana

P. africana is commonly known as African mesquite, and is also traditionally used as a medicine. The oral administration of leaves and bark of this plant is used for the treatment of malaria in Sélingué subdistrict in Mali [19] and Nsukka Local Government Area in south-eastern Nigeria [21].

In addition to malaria, various parts of *P. africana*, including roots, leaves and bark, are also used as analgesic and anti-inflammatory in Guinea-Bissau [22] and for the treatment of pains, pregnancy-related conditions (childbirth, breastfeeding, newborn diseases), and skin inflammations (i.e., wounds, burns) in north-west of Nigeria [20].

3.4. Other Prosopis Plants

The resin of *P. alba* and *P. nigra*, and the leaves of *P. ruscifolia* have also been consumed by the Wichí people of Salta province in Argentina against conjunctivitis, post-abortion pain, ocular trauma, stomachache, pimples or rash, scabies, callouses, fever, birth or postpartum pains, diarrhea, pediculosis and otitisSuárez [23].

A study carried out in South America (Bustamante, Nuevo León, Mexico), also pointed out that the ingestion of *P. glandulosa* inflorescences may be useful to relief stomach pain [25]. In addition to the above, in Jahrom, Iran, *P. farcta* fruits have been consumed to prevent constipation and to reduce fever [24], whereas *P. spicigera* bark, leaves and flowers are used for the treatment of asthma in Pakistan [4].

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