

# *Opuntia ficus-indica* (Cactaceae): A review

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## **Abstract**

*Opuntia ficus-indica*, commonly referred to as prickly pear, belongs to the family Cactaceae. It is used as both for food and medicine in different countries throughout the world. It contains diverse bioactive compounds which make this plant to withstand extreme drought conditions in relatively poor soil. The present review is aimed at the morphological characters of *Opuntia ficus-indica* with its food and medicinal values.

*Keywords: Opuntia, Cactaceae, medicinal values, food values*

## **1. Introduction**

Cactaceae, an angiospermic family, belongs to the order Caryophyllales. Members of the family Cactaceae are mostly perennial xerophytic shrubs, rarely trees and sometimes epiphytes. The habitat of Cactaceae ranges from dry and arid deserts to semi-desert regions with maximum temperature during daytime and cold nights with high evaporation rates (Basu et al. 2014). The family comprises about 1800 species with their significant morphological and physiological adaptation to drought. Although they are found in a range of environments, they represent one of the world's most spectacular desert radiations. The great majority of cactus

diversity is found in two major lineages, the Opuntioideae and Cactoideae. Most members of these groups are what might be regarded as “typical” cacti. They have succulent stem with only vestigial or ephemeral leaves, a well-developed photosynthetic stem cortex with CAM carbon metabolism, specialized “collapsible” xylem cells that aid in water storage (Mauseth 1995; Edwards et al. 2005), deeply recessed inferior ovaries, and specialized short shoots (areoles) with very reduced internodes that produce spines, new long shoots, glochids (in Opuntioideae), and flowers (Edwards et al. 2005). Cactaceae is one of the most important families in the plant kingdom that comprises many endangered species (Goettsch et al. 2015; Korotkova et al. 2021). Almost the entire family is cited in CITES Appendix II as protected and several species are cited in Appendix I as threatened with extinction (Sajeva et al. 2007).

## **2. Cactaceae (Cactus Family)**

### **2.1. General physiognomy**

Members of the family Cactaceae are having enlarged, fleshy green photosynthetic stems studded with clusters of spines arranged in rows or in spirals along the stem and producing showy, multi-petaled flowers with numerous stamens and an inferior ovary.

### **2.2. Vegetative morphology**

Cacti in California are all leafless (some tropical cacti in the genus *Pereskia* have large leaves), and grow as stem-succulent plants varying from small globose individuals 3–5 cm in diameter to giant columnar stems 50 cm in diameter and sometimes 10 or more meters tall. In the prickly pears (genus *Opuntia*) the stems are flat and have determinate growth, producing a chained series of oblong or circular pads called cladodes. Leaves are usually transformed into spines and clustered into sharp, prickly bundles called areoles, derived from axillary buds and located at the nodes of the stems. Areoles are arranged along the stem in rows or in spirals. In large cacti, such as the saguaro, the stems are ribbed longitudinally in distinct rows, while in small globose cacti the areoles are arranged spirally around the stem usually sitting on tightly-

packed, prominent nipple-like tubercles. Each areole features several to many radiating spines that may have different colors.

### **2.3.Reproductive morphology**

Flowers are usually large and showy, often arranged in a circle near the top crown of the stems. Flowers may be white, cream-colored, yellow, pink, rose-red, greenish, brownish, or other colors. Flowers display numerous spirally-arranged sepals that grade into numerous petals, together with numerous separate stamens and a single pistil with an inferior ovary and many finger-like stigma lobes. The fruits are berries, often very fleshy and sweet, commonly bright red or yellow when ripe. Because the ovary is inferior, the fruits, like the stems, are covered with areoles (clusters of spines).

The *Opuntia* genus, belonging to the Cactaceae family, comprises about 300 plant species, and among them, *Opuntia ficus indica* or Prickly Pear is considered the most significant species due to its food and medicinal values. It can grow in arid and semi-arid climates with a geographical distribution encompassing Mexico, Latin America, South Africa and the Mediterranean countries (Butera et al. 2002).

## **3. *Opuntia ficus indica***

### **3.1.Morphology**

The aerial part of the plant is characterized by a system of branches, cladodes, or paddles, which play an important role as water reservoirs. Branches are fleshy and capable of storing considerable amounts of water that they can use it during excessive water loss. For this reason, the plant can withstand prolonged drought conditions. The blades are photosynthetic also play as a water reservoir and use dew as a water source. The blades vary in size, usually 20-40 cm long and 15-30 cm wide, with a thickness of up to 5 cm. The trunk is formed by the aging of the primary, or first-forming blades, which initially take on a dark color (Figure 1).



*Figure 1: Vegetative parts of Opuntia ficus-indica*



*Figure 2: Flower of Opuntia ficus-indica*

Joints flattened, narrowly elliptic to ovate, varying in size, about 30-60 cm long and 6-12 cm broad, attenuate below, often acute above, thick. Leaves, if developed, are minute, subulate, and early deciduous. The leaves turn yellow and fall off within 4-5 weeks, leaving the buds surrounded by thorns where they were attached. The buds are of two types: flowering and vegetative, i.e., they can give rise to fruit or new blades or cladodes respectively. Flower buds are spherical in shape, whereas vegetative buds are flattened. The flowers are hermaphroditic, i.e., they have both female organs (pistils) and male organs (stamens); they have a disepalous calyx (with separate sepals) and a yellow dipetalous corolla (with separate petals); the ovary is inferior. The color of the flowers, depending on the variety, can be yellow, green, yellow-orange, and red (Figure 2). Fruits are berry, ellipsoid, about 7 cm long, reddish, succulent, and edible. Seeds about 5 mm long. The root system is expanded, but shallow. The root mass is located within the first 50 cm depth of the soil, so the plants do not require deep soil (Saxena and Brahmam 1995; Prisa 2021).

### **3.2. Flowering & Fruiting**

The flowering period begins in May and lasts until the first week of June.

### **3.3. Distribution**

Native to Mexico Central, Mexico Gulf, Mexico Northeast, Mexico Northwest, Mexico Southwest.

Prickly Pear is employed in health, nutrition, and cosmetics in the forms of tea, jam, juice and oil extracted from prickly pear seeds. It is used as a herbal remedy for diverse health problems in different countries.

## **4. Medicinal values**

*Opuntia ficus indica* shows diverse bioactive compounds which are used in the treatment of various diseases and disorders. The leaves (paddles) have many vital phytochemicals, fiber, antioxidants, vitamins, and minerals that play an important role in the improvement of health

(Kuti 2004). It is known for its high content in polyphenols exhibiting antioxidant and anti-inflammatory properties. Flowers and fruits of *Opuntia ficus indica* are given as anti-ulcerogenic or antidiarrheal agents. Flowers are also administered as an oral anti-hemorrhoid medication and cladode sap as a treatment for whooping cough. Fruits and flowers are featured for their interesting contents of antioxidants, pectin polysaccharides and fibers. Interestingly, alkaloids, indicaxanthin, neobetainin, and various flavonoids have been isolated from the cactus. *Opuntia ficus-indica* cladodes are rich in nicotiflorin and show anti-inflammatory and neuroprotective mechanism used to reduce brain infarct size, to attenuate neurological deficits induced by ischemia. Nicotiflorin has a protective effect on memory dysfunction, nicotiflorin also protects against energy metabolism failure and oxidative stress. The medicinal properties of this cactus are numerous, and research has shown that the fruits are effective in the reticence of cancer growth and against colon and prostate cancer cells (Chavez-Santescoy et al. 2009; El-Mostafa et al. 2014).

## **5. Food values**

Indigenous populations consume substantial amounts of either fresh or dry fruits of *Opuntia ficus-indica* as food. *Opuntia ficus indica* is an edible cactus that serves as a vegetable also. Edible cactus is made up of fleshy oval leaves referred to as pads or sometimes called paddles. The vegetative part that is the young cladode and pad known as nopal or nopalito. The entire parts of the cactus are edible, the fruit commonly referred to as prickly pear. The soft paddles are good sources of nutritional fiber and it contains pectin, mucilage, and hemicellulose. These substances that are present assist in lowering body weight, cholesterol, and blood glucose levels in the human body (Wolfram et al. 2003). Consuming nopales not only lower blood sugar level in diabetic patients but also assist in the protection of the liver from fatty liver disease (Moran-Ramos 2012; Osuna-Martinez et al. 2014).

## 6. Conclusion

Medicinal food play an important role in providing nutrition and secondary metabolites. They are important nutraceutical but most of such plants are unexplored. *Opuntia ficus-indica*, an unexplored plant having food and medicinal values. Hence, there is need of biochemical and pharmacological analysis for proper utilization of this medicinal food plant.

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