

## A REVIEW PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILING OF HYLOCEREUS UNDATUS FRUIT

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### ABSTRACT

*Hylocereus undatus*, commonly known as dragon fruit, has garnered significant attention for its medicinal properties and nutritional benefits. This review comprehensively examines the botanical characteristics, phytochemical composition, and pharmacological activities of *H. undatus* fruit. The fruit's rich antioxidant, anti-inflammatory, antibacterial and antidiabetic properties are highlighted, alongside its potential therapeutic applications in managing various diseases. The reviewed literature underscores *H. undatus*'s promise as a valuable resource for functional foods, pharmaceuticals, and cosmeceuticals. Future research directions and commercial exploitation prospects are discussed.

**Nutritional/Pharmacological** Antioxidant activity, Anti-inflammatory properties, Antidiabetic effects, cardiovascular health, Immunomodulatory, Phytochemicals, Flavonoids, Betacyanins.

**Medicinal/Therapeutic** Anticancer properties, Wound healing, Anti-bacterial, Anti-viral, Neuroprotective, Anti-aging.

**Agricultural/Cultivation** Tropical agriculture, Fruit cultivation, Plant breeding, Post-harvest management, Irrigation.

**Health Benefits** Digestive health, Anti-oxidative stress, Anti-inflammatory, Immune system support, Skin health

**Chemical Composition** Vitamin C, Vitamin B, Minerals (potassium, magnesium) Fiber, Betacyanin, Polyphenols

**Keywords:** Botanical/Scientific- *Hylocereus Undatus*, Dragon Fruit, Pitaya, Cactaceae Family, Tropical Fruit.

### I. INTRODUCTION

The dragon fruit, a newly introduced super fruit in India, is seen as a promising and profitable fruit crop. Fruit has a very appealing colour and mellow mouth melting pulp with black colour edible seed embedded in the pulp, as well as tremendous nutritive properties, which attracts growers from all over India to cultivate this fruit crop that originated in Mexico and Central and South America. It is a long-day plant with a lovely night-blooming flower known as "Noble Woman" or "Queen of the Night." Strawberry Pear, Dragon Seed, Pithaya, Night Blooming Cereus, Belle of the Night, Cinderella Vine, and Jesus in the Cradle are some of the other names for the fruit.[1]Plants contain a broad range of organic molecules that do not directly contribute to the plant's growth and development. Secondary metabolites are the name for these molecules. Food additives, flavourings, pharmaceuticals, and other synthetic products have all been derived from secondary metabolites from plants.[2].The dragon fruit, a super fruit that has just lately been brought to India, is regarded as a fruit crop with great potential for profit. The fruit's striking colour, smooth, mouth-melting pulp, and delicious black seed embedded in the pulp, combined with its exceptional nutritional value, draw producers from all across India to plant this fruit crop [3]. Although it is eaten, the existence of dragon fruit among humans is not limited to the eating of fresh fruit or fruit juice [8]. The government of India is currently promoting the production of dragon fruit through a number of programs. [4]

#### Propagation

Cuttings of the *H. undatus* are most commonly obtained by severing foot-long lateral branches at a stem segment. Making a slant cut on the end of the stem that will be inserted to improve rooting in the soil Cutting should be cured for a minimum of 24 hours. Before planting, keep it in a cool, dry place for 5-7 days.Cutting mature stems is preferable because they are more resistant to insect and snail damage. Cuttings can be planted directly in the ground. Use a well-drained potting medium in the field or in pots.[5]



### Cultivation

Plantings at a high density of between 1100 and 1350 plants per hectare can be done commercially. It can take up to five years for a plant to reach full commercial production capacity. When can yields of 20 to 30 tonnes per hectare be expected, Hylocereus has custom-made to measure in dry conditions, as expected; 7 tropical climates with a reasonable amount of rainfall, After flowering, the dragon fruit sets on the cactus-like trees 30–50 days later, with 5–6 harvest cycles possible every year It is free to cultivate in various regions, It has become a weed and is classified as a cuckoo invasive weed in the United States[6]

### INFORMATION

#### Hylocereus Undatus Fruit



**Fig:** Hylocereus Undatus Fruit

## II. PLANT PROFILE

**Synonyms-** Dragon fruit, Pitahaya, Pitaya, Belle of the night, Queen of the night, Red pitahaya, Strawberry pear, Night-blooming cereus, Moonlight cactus

**Common name-** Chinese huǒlóngguǒ (fire dragon fruit), French Cierge-lézard, Pithaya rouge, Pitaya, Mexico Junco, Flor de caliz, Pitajava, Pitahaya roja, English Strawberry Pear, Dragon fruit, Red pitaya, Night Blooming Cereus, Belle of the Night, Cinderella Plant, Queen of the Night, Jesus in the Cradle, German Distelbirne, Echtestachelbrin, Spanish Flor de caliz, Junco tapatio, Pitahaya Orejona, Pitajaya, Reina de la noche, Hindi Dragon Fruit.[7]

**Geographical source-** Dragon fruit is now cultivated in many tropical and subtropical regions around the world, including East Asia, South Asia, Southeast Asia, the United States, the Caribbean, and Australia.

#### Morphological characteristics-

**Shape:** The fruit is oblong in shape

**Size:** The fruit can be 15–22 cm long and weigh 300–800 g

**Skin:** The fruit is covered with large, long scales that are red and green at the tips

**Flesh:** The flesh is white, pink, red, or magenta, depending on the species

**Seeds:** The fruit contains many small, black seeds

#### Taxonomical Position

Numerous names for the plant exist, including dragon fruit, Pitaya, pitahaya, strawberry pear, night-blooming cereus, Belle of the Night, and Cinderella plant. There are eighteen species in the genus Hylocereus (A. Berger) Britton and Rose (1909)[8]

**Table 1:** Taxonomical classification of dragon fruits

<b>Domain</b>	<b>Eukaryota</b>
Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Caryophyllidae
Order	Caryophyllales
Family	Cactaceae
Subfamily	Cereoideae
Tribe	Hylocereae
Genus	Hylocereus

**Nutritional and Pharmacological aspects of Dragon fruit**

The pitaya fruit, which has a lot of potential in Brazilian cuisine because of its sweet taste, can be used in jams, juices, ice cream, and candy, or it can be eaten plain in the wild. The pitaya fruit, which has become popular due to its sweet flavour, with a lot of potential for use in Brazilian cuisine, jams, juices, ice cream and candy can all be made with it, or it can simply be eaten, in its natural state investigated the wound-healing properties of aqueous extracts from *H. undatus* leaves, shells, fruit pulp, and flowers, and found promising results. All parts of the fruit have healing effects on mice. Healing takes longer in diabetic animals, and topical applications of *H. undatus* resulted in significant increases in hydroxyproline, tensile strength, total protein, and phospholipids. Improved epithelialization and DNA collagen content as a result, healing is made easier. However, in this study, The *H. hypoglycaemic* activity was not observed by the authors. *Undatus* is the Latin word for “without.” Investigated the antiproliferative activity of red pitaya in melanoma cells to see if the fruit could be used to treat the cancer. It is thought to be a promising anticancer agent.[9]



**Table 2:** Phytochemicals present in Dragon fruit

Components	Reagent	Note	Results of fruit extract tested
Proteins	Biuret test	Purple blue	Positive
Steroids	Liebermann Burchard test	Yellow ppt	Positive
Carbohydrates	Molisch test Benedict test	Violet ring Orange ppt	Positive
Alkaloids	Mayer’s reagent	White ppt	Positive

	Wagner's reagent	Brown ppt	
Phenolic compounds	Ferric chloride test	Green ppt	Positive
Tannins and Flavonoids	Lead acetate	Yellow white ppt	Positive
Saponins	Fast stirring	Dense foam for long time	Positive [10]

**Botanical description**

Dragon fruit stems have a propensity to rise, spread, and sprawl. They also have a great deal of branching. There could be four to seven fruits, with a maximum length of ten meters and a maximum diameter of ten to twelve centimetres per fruit. Areoles are spaced about 2 to 5 cm apart. The spines on adult branches range in length from 1 to 4 mm and are nearly conical to acicular. The hues range from greyish-brown to blue-green. They yield fruits that are oblong to oval in shape. It is 4-10 cm long and 3-8 cm thick. It features bracteoles and a broad, deep red frame. These fruits are made of a white pulp that contains a few edible tiny black seeds scattered throughout. For one cycle, the pitaya florescence should last roughly five days.[11]

The following provides a detailed description of the five species that were classified by Britton and Rose in 1963: The long green stems of *H. Undatus* (Haw.) Britton & Rose are somewhat horny toward the age margins. Its long (up to 29 cm) flowers have green, or yellow-green, outer perianth segments and pure white inner perianth segments. The rosy-red fruits are oblong in shape and have large, long scales that are red and green at the tips. They measure 15 to 22 cm in length and weigh about 300 to 800 g. *Homo sapiens* (Weing) Britton & Rose produces very large, 25 cm flowers with margins; the segments of the outer perianth are roughly reddish, the segments of the middle perianth are golden, and the segments of the inner perianth are white.[12]

**Microscopy**

**Scanning Electron Microscopy (SEM)**

A desiccator was used to dry the pollen grains that were collected from flowers during a thesis and placed on adhesive tape that was fastened to an aluminium stub. Stigmas of pollinated and unpollinated flowers were fixed in FAA (37% formaldehyde, 100% acetic acid, 80% alcohol) for 24 hours before being put in a vacuum pump to extract air from the tissue.

**Light Microscopy (LM)**

After subjecting the samples to a progressive series of alcohol (30, 50, 70, 75, 90, 95, and 100%), methyl benzoate containing 1% celloidin was added. After that, the samples were cleaned in xylene and progressively infiltrated over the course of an overnight period in serial ratios of xylene and paraffin (3:1, 1:1, 1:3, and 0:1).

**Fluorescence Microscopy**

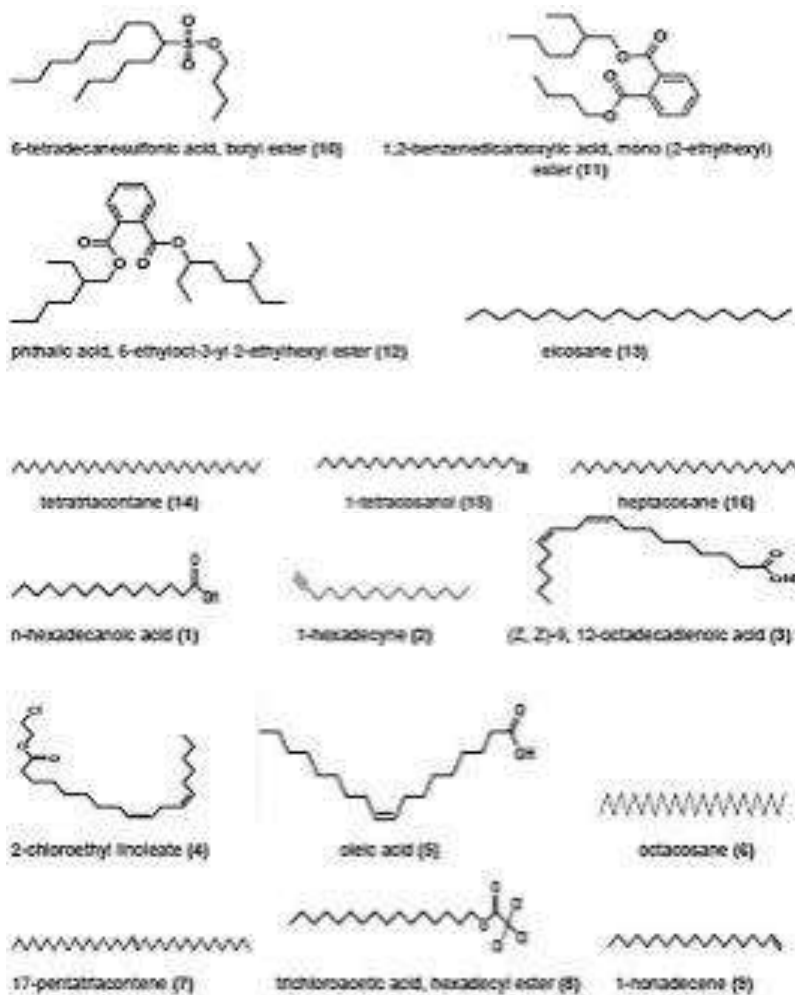
With a razor blade, longitudinal and transverse sections of fixed styles were cut from the style base (close to the ovary), The middle portion of the style (10 cm below the stigma), and the top of the style (near the stigma). The samples were cleaned and allowed to soften for an entire night at room temperature (25±2°C) in 1.0 mol·L<sup>-1</sup> of NaOH (Adapted from Martin, 1959). After that, sections were cleaned, soaked in deionized water for two hours, and stained for the next two days with 1.0% decolorized aniline blue in 0.1 mol·L<sup>-1</sup> potassium phosphate (K<sub>3</sub>PO<sub>4</sub>) solution. Samples were viewed under a Leica DMRA II fluorescence microscope (Germany) fitted with a UV excitation filter set to a wavelength of 356 nm after being gently compressed under a coverslip.[13]

Sr.no	Present Bioactive Compound	Therapeutic Effects of Bioactive Compound
1	Alkaloids	Antiplatelet Agents, Anticancer Agents, Antibacterial Agents. Anesthetic Property, Anti-inflammatory
2	Phenols	Antioxidant, Antibacterial/Antifungal/Antiviral, Anticancer
3	Saponins	Anti-inflammatory, Antimicrobial, Anticancer
4	Steroid	Anabolic Properties, Anti-inflammatory, Cholesterol Lowering Properties, Antidiabetic,

		Analgasic, Anthelmintic activities
5	Tannins	Antioxidant, Antibacterial, Anti-carcinogen, Antimutagenic, Styptic and astringent Properties, Anti-adhesive
6	Terpenoids	Anticancer, Antimicrobial, Antifungal, Antiviral, Antihyperglycemic, Analgasic, Anti-inflammatory, Anti-parasitic

**Phytochemistry**

The nutrients and phytochemicals found in dragon fruit are beneficial to the body. Numerous investigations have revealed that dragon fruit may be able to shield people from disease. 33 the value of the fruits of the *Hylocereus cactus* has increased lately. Certain phytochemicals found in dragon fruit or pitaya include carbohydrates, proteins, saponin phenolic compounds, Terpenoids, oils, flavonoids, tannins, phenols, coumarin , and steroids. Nutritional analyses show that the fruit contains all the nutrients required for a balanced diet, including minerals, Fat, vitamins, and crude fiber [16]. An overview of the current bioactive substances discovered in dragon fruit (*Hylocereus Spp.*) stems and their potential medicinal uses.[14]



**Fig:** Chemical compounds of Dragon fruit

**Pharmacological actions of Dragon fruit (*Hylocereus undatus*)**

**Antioxidant activity**

Because the peel contains more flavonoids than the flesh, ethanolic extracts of the *H. undatus* peel and flesh were proposed to have different antioxidant capacities.[15]

**Anti-cancer activity**

Numerous studies have demonstrated the anticancer properties of dragon fruit's flavonoids, polyphenols, and betanin. In just one dosage, the dragon fruit skin that was extracted using a 50:50 mixture of water and ethanol solvent demonstrated antiproliferative activity against human hepatocellular carcinoma cells. The precise nature of the anticancer activity of dragon fruit is still being investigated and cannot be determined with certainty. Nevertheless, prior studies have indicated that the anticancer effect of polyphenols in dragon fruit may be mediated through a mediated pathway and factor suppression on nucleic-kappa B. Growth factor receptors, anti-inflammatory, antioxidant mechanisms, and inhibition of angiogenesis, induction of cell cycle arrest and apoptosis, and activation of protein kinase. The natural antioxidant lycopene, which is found in red flesh, is known to prevent cancer. Antioxidants shield cells from potentially harmful reactive oxygen species and stop the production of free radicals, which can lead to cancer.[16]

**Antimicrobial activity**

The antibacterial activity of *H. undatus* peel extracts in ethanol, chloroform, and hexane were investigated. According to the results of the disc diffusion assay, there was an inhibition region of 7–9 mm against Gram-positive and Gram-negative bacteria bacilli.[17]

**Anti-inflammatory activity**

Because of its com-Position, including compounds such as betalains and squalene, Dragon fruit has antioxidant and anti-inflam-Matory properties. Rodriguez et al. (2016) reported anti-Inflammatory activity of maltodextrin encapsulated and non-encapsulated betalains from *H. polyrhizus* peel extract. Betalains are unstable and sensitive to degrada-Tive factors such as temperature, pH, oxygen, or light, but their bioactivity can be extended by encapsulation through the addition of a protective and impermeable layer (Jackman and Smith 1996; Mulinacci and Inno-Centi 2012; Rodriguez et al. 2016).

**Antifungal activity**

Two yeasts, *Candida albicans* and *Rhizoctonia solani*, and four molds, *Aspergillus flavus*, *Fusarium oxysporum*, *Botrytis cinerea*, and *Cladosporium herbarum*-the research panel that includes laboratory control strains obtained from the american Type Culture Collection (ATCC)-are present in extracts and fractions of flesh and peels of red pitaya fruits that exhibit polyphenol antifungal activity [18]

**Antidiabetic activity**

Numerous investigations have demonstrated the antidiabetic effect of dragon fruit. Red dragon fruit can help patients with Type II Diabetes lower their blood glucose levels. Glucose is the component in red dragon fruit that lowers blood sugar. Apart from glucose, the dietary fiber in dragon fruit also serves to lessen the rate at which food is broken down in the intestines, which lowers the production of blood glucose. The application of dragon fruit extends beyond just its flesh in terms of its antidiabetic properties. The skin and seeds of dragon fruit also have anti-diabetic properties. Dragon fruit seeds have saponins in them that dissolve in water extracts and have anti-diabetic properties, particularly for type II Diabetics. In the meantime, soluble fibres found in dragon fruit skin are thought to have the ability to control the body's blood sugar levels .[19]

**Antiulcer activity**

Topical quercetin from the skin of *Hylocereus polyrhizus*, or red dragon fruit, has antiulcer properties. Results showing complete distress in 35% of cases within 2-4 days and in 90% of cases within 4-7 days attest to this. Quercetin helps with mild symptom relief and lowering the frequency of relapses.[20]

**Anti-infertility activity**

According to an experiment, extract from dragon fruit can enhance testicular histology and preserve sperm motility. gallic acid, an antioxidant found in white dragon, has the tendency to improve spermatozoa quality by increasing their motility, quantity, and morphology in the epididymis.[21]

**Antiplatelet activity**

Antiplatelet action because ethanol and ethyl acetate extracts from dragon fruit have inhibitory effects on platelet aggregations caused by different agonists in a concentration-dependent manner, the fruit has antiplatelet activity.[22]

**Cardio-protective Effect**

Polyphenol contents in *H. polyrhizus* flesh also possessed anti-thrombotic effects which further enhanced its cardioprotective properties.[23]

**Neuroprotective activity**

Among the many health advantages of dragon fruit is its connection to nerve work's neuroprotective properties, as was previously mentioned. Dragon fruit's phytochemical composition actively contributes to neuroprotective effects, particularly in averting neurodegenerative illnesses. Dragon fruit contains essential fatty acids, a phytochemical that actively participates in neuroprotector activity and may prevent neurodegenerative diseases.[24]

**Analgesic activity**

Gallic acid (3, 4, 5-trihydroxybenzoic acid), an organic compound found in plant materials with antioxidant, antibacterial, antiviral, and analgesic properties, is present in pitaya and many other plants.

**III. CONCLUSION**

Dragon fruit is a fruit that has several health benefits from both the fruit and the peel. The distinctive red hue of dragon fruit is accompanied by a delicate, scaly peel and a significant number of black seeds. The fruit peel, which makes up 22% of the fruit, has a high concentration of natural anthocyanin colors and polyphenols, which act as antioxidants. Dragon fruit has the potential to be used in herbal tea drinking items with natural hues and high antioxidant content. Dragon fruit crops are sorted by size, color, and physical flaws using human senses. At room temperature, dragon fruit can be stored for up to ten days. At 14 °C, dragon fruit is still in a respectably decent state after two weeks of storage. Dragon fruit skin flesh can be used to make herbal beverages, jelly, syrup, and other health-promoting functional food products.

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