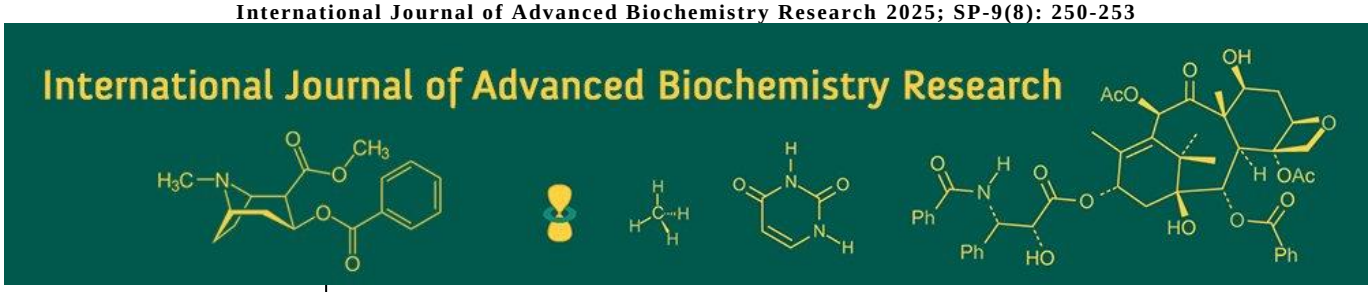

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Dragon fruit: A review on nutritional value and health profits

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Abstract
Dragon fruit known as tropical fruit with an astonishing appearance and it has became very popular due to its high nutritional value and bioactive compounds. This fruit is a very good source of essential nutrients, including vitamins C and E, fiber, iron, and magnesium, which add to its health-promoting properties. Dragon fruit strengthens the immune system of the human body and it is also used in the diabetes, heart diseases treatment and in maintaining healthy body weight and it also contains beneficial antioxidants i.e. betacyanins, Flavonoids. This review shows the nutritional information of dragon fruit and it has potential to become an integral part of a healthy diet.

Keywords: Dragon fruit, nutritional, antioxidants, nutrients etc.

Introduction
Dragon fruit is the tropical exotic fruit of climbing cactus vine of the genus Hylocereus (chromosome number 2n = 22) family Cactaceae. It is also known as pitaya, or strawberry pear or kamlam. Although the pitaya is native to the tropical areas of North, Central and South America, it is now cultivated worldwide due to its commercial interest, not demanding very special cultivation requirements, i.e. easy adaptation to high temperature and light intensity, high drought tolerance and tolerance to different soil salinities (Nobel and La Barrera 2004) [21]; Nie *et al.* 2015) [20]; (Crane *et al.* 2017) [5]; (Mercado-Silva 2018) [77]. Pitaya is commercially cultivated in more than 20 tropical and subtropical countries such as Indonesia, Colombia, Bahamas, Bermuda, Israel, the Philippines, Malaysia, Mexico, Myanmar, Nicaragua, northern Australia, Okinawa (Japan), southern China, southern Florida, Sri Lanka, Thailand, Vietnam, Taiwan, Bangladesh, and the West Indies (Mercado-Silva 2018) [17]. Commercially, four species of dragon fruit are contributed to the global market:

1. Red skin and white flesh (*Hylocereus undatus*), primarily from Vietnam and Thailand (Fig. 1).They are also termed as *Selenicereus Undatus*. It is the most widely grown type of dragon fruit. It is a Dragon fruit with white flesh and pink skin. In this type species, largest and most popular dragon fruit Thompson (1.5 pounds), semi-sweet pulp almost like a grape taste Harpua and more delicious, sweeter when chilled, Neitzel.
2. Red skin and red flesh (*Hylocereus polyrhizus*), primarily from Malaysia and Israel (Fig. 1).It is also known as *Hylocereus costaricensis*. It is a sweet-type Dragon fruit with red flesh and red skin have a texture equivalent to a Kiwi. In addition, it can be eaten raw, but it can also be used in smoothies. The downside of to dragon fruits is that it can stain your hands red when eating. But blending them with other solid fruit tastes like pineapple will make its more pleasurable. Red dragon fruit cultivars are Costa Rican Sunset (Natura Mystic), Zamorano and Red Jaina.
3. Red skin and purple flesh (*Hylocereus costaricensis*), primarily from Guatemala, Nicaragua, Ecuador, and Israel (Fig. 1).It is a Dragon fruit with soft to hot pink and red skin. This type of dragon fruit species can be cultivated on different types of soil and climatic condition. This type of dragon fruit varieties are Delight, Cosmic Charlie (Delight) and Voodoo Child (Voodoo Child).
4. Yellow skin and white flesh (*Hylocereus megalanthus*) from Colombia Ecuador (Fig. 1). It is also known as *Selenicereus Megalanthus*. This dragon fruit species has firm white flesh with a yellow-skinned scaling pattern and it is native to South America. This type of dragon fruit is the highly tasty.

Fig 1: Worldwide dragon fruit species

In the Worldwide, the production share of different species red skin with white flesh, red skin with purple flesh, red skin with red flesh, and yellow skin with white flesh are around 94%, 4.0%, 1.5%, and 0.5%, respectively . Top producer countries of dragon fruit are Philippines, Taiwan, Malaysia, Vietnam, China, Indonesia, Thailand, India, USA, and Cambodia.

Dragon fruit (Pitaya) production in India

Dragon fruit was introduced during the late 1990s in India, (Arivalgan *et al.*, 2021) [2]. Subsequently, area under dragon fruit cultivation was steadily enlarged from 4 to 400 ha in different states during 2005-2017. Primarily, dragon fruit cultivation was started by the farmers of Karnataka, Maharashtra, Gujarat, Kerala, Tamil Nadu, Odisha, West Bengal, Andhra Pradesh, Telangana and Andaman & Nicobar Islands states. Now, its cultivation has expanded too many states i.e. Rajasthan, Punjab, Haryana, Madhya Pradesh, Uttar Pradesh and North Eastern States. According to recent estimates, India's dragon fruit production enlarged considerably to more than 12, 000 tons over an area of 3, 000-4, 000 ha in 2020 (Wakchaure *et al.*, 2021) [30].

Nutritional Values of Dragon fruit (Pitaya)

Dragon fruit is rich in essential vitamins, minerals and antioxidants but also low in calories. 100-gram of Dragon fruit contains about 50-60 calories, an excellent option for weight management (Mande *et al.*, 2023) [16]. It promotes healthy digestive system due to high in dietary fiber and maintains stable blood sugar levels. Pitaya boosts the immune system and enhances skin health because it is a good source of vitamin C and also acts as an antioxidant due to vitamin E (Monteiro *et al.*, 2023) [18].

The dragon fruit also provides essential minerals like magnesium, which is vital for muscle and nerve function, iron, which supports red blood cell production and calcium, for bone health (Sarkar *et al.*, 2023) [26]. Furthermore, dragon fruit is rich in antioxidants, such as betacyanins and flavonoids, which reduce inflammation and help to combat oxidative stress. (Mahayothee *et al.*, 2019) [14]. Nutritive value per 100 g of dragon fruit pulp is as under (Table 1).

Table 1: Nutrient, mineral and vitamin content of dragon fruit (per 100 g)

S. No.	Nutrient	Amount (per 100 g)	Mineral	Amount (per 100 g)	Vitamin	Amount (per 100 g)
1.	Calories	50-60 kcal	Iron	1.9 mg	Vitamin C	3-4 mg
2.	Carbohydrates	11-13 g	Magnesium	10 mg	Vitamin E	0.1-0.5 mg
3.	Dietary Fiber	3 g	Calcium	6-10 mg	Vitamin A	0.012 mg (12 IU)
4.	Sugars	8-9 g	Phosphorus	25 mg	Vitamin B1 (Thiamine)	0.03 mg
5.	Protein	1-2 g	Potassium	110 mg	Vitamin B2 (Riboflavin)	0.04 mg
6.	Fat	0.1-0.6 g	Sodium	0-13 mg	Vitamin B3 (Niacin)	0.16 mg
7.	Water	87 g	Zinc	0.35 mg	Source: Jaafar *et al.* (2009) [4]	
	Source: Sinha *et al.* (2018) [28].		Source: Khalili *et al.* (2006) [11].			

Health profits of dragon fruit (Pitaya)

Antioxidant efficacy

It is rich in antioxidants, which play a vital role in protecting the body from reducing inflammation and oxidative stress. The primary antioxidants betacyanins, flavonoids, phenolic acids, and vitamins C and E found in dragon fruit (Al-Mekhlafi *et al.*, 2021) [1]. Betacyanins, have been shown to reduce oxidative damage and possess anti-inflammatory and anticancer properties which responsible for the fruit's vibrant red color, (Choo *et al.*, 2018) [3]. Flavonoids contribute to reducing the risk of cardiovascular diseases and heart health by improving blood circulation. Free radicals, which can damage cells and lead to chronic diseases such as cancer neutralize through Phenolic acids (Rahman *et al.*, 2021) [24].

Anti-diabetic intent

Primarily, it exhibits anti-diabetic properties due to its high fiber content and bioactive compounds i.e. betacyanins and flavonoids. it helps sluggish the absorption of sugars, leading to better glycemic control and reduced blood sugar spikes after meals (Tarte *et al.*, 2023) [29]. Furthermore, pitaya's low glycemic index ensures gradual glucose release into the bloodstream. Studies advise that its bioactive compounds may improve insulin sensitivity, promoting better glucose utilization in cells (Erika *et al.*, 2024) [7]. The antioxidants present in dragon fruit, protect pancreatic β-cells from oxidative stress, preserving their role in insulin production (Malik *et al.*, 2023) [15].

Anti-microbial properties

Dragon fruit has antimicrobial properties due to its bioactive compounds flavonoids, phenolic acids, and betacyanins etc. They have ability to inhibit the growth of various pathogenic bacteria and fungi (Hendra *et al.*, 2019) [8]. Studies have revealed that pitaya extracts are potent against bacterial strains such as *Escherichia coli* and *Staphylococcus aureus*, as well as somewhat fungal species (Lim *et al.*, 2023) [13]. Dragon fruit a potential natural alternative to promoting its use in food preservation and therapeutic applications for combating infections.

Anti-cancer properties

Dragon fruit shows anticancer activity due to its rich content of antioxidants like betacyanins, flavonoids, and phenolic acids. phenolic acids and Flavonoids giving contribution by

reducing inflammation, a feature closely associated with tumor development (Saenjum *et al.*, 2021) [25]. Investigations have shown that dragon fruit extracts can reduce the growth of various cancer cells, for instance breast and colon cancer cells (Padmavathy *et al.*, 2021) [22].

Anti-anemia actions

Dragon fruit's anti-anemia characters are primarily due to its iron availability, which maintains red blood cell production and enhances hemoglobin synthesis and it is crucial for oxygen transport in the body (Khuzaimah *et al.*, 2023) [12]. Dragon fruit helps to combat iron deficiency which reduces the risk of anemia (Damayanti *et al.*, 2023) [6]. Studies point out that regular intake of pitaya can improve hemoglobin levels and lessen symptoms such as fatigue and weakness associated with anemia, making it a valuable dietary addition (Mulyani and Sari, 2020) [19].

Hepato-protective actions

Due to its rich antioxidant content including betacyanins, flavonoids, and phenolic acids, Dragon fruit exhibits hepatoprotective activity. It helps to neutralize free radicals, reducing oxidative stress in liver cells which is a key factor in liver damage (Jayaseelan *et al.*, 2023) [10]. Betacyanins, protect against lipid peroxidation in liver tissues and preventing cell injury (Huang *et al.*, 2021) [9].

Anti-hyperlipidemic properties

Due to its antioxidants, fiber and bioactive compounds like flavonoids and betacyanins, Pitaya exhibits anti-hyperlipidemic properties. The high fiber content facilitates to reduce cholesterol absorption in the gut, minimizing total cholesterol and low-density lipoprotein (bad cholesterol) levels (Prajapati *et al.*, 2022) [23]. Investigations have shown that consumption of dragon fruit can improve lipid profiles, lowering triglycerides and low-density lipoprotein levels while increasing high-density lipoprotein (good cholesterol), (Setiawan *et al.*, 2018) [27].

Conclusion

Due to rich in essential nutrients, vitamins, minerals and antioxidants drag¬on fruit become more valuable fruit. Their Nutritional and health benefit brings numerous advantages to promote human health i.e. improve digestive system, boosts immunity and helps to manage weight. Dragon fruit is emerging as a super fruit with two dimensional nutritional and medicinal properties which has long life health advantages and disease prevention ability. Due to presence of betalains, flavonoids, polyphenols, terpenoids and steroids, saponins, alkaloids, tannins, and carotenoids dragon fruit can be effective and sustainable alternatives to synthetic drugs for the prevention and treatment of many diseases such as diabetes, obesity cancer and pathogenic agents. Further studies are yet needed to understand the it's more health benefits.

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