

Dragon Fruit: A New-Age Fruit for Nutrition, Income and Sustainable Farming

Kamalam fruit is emerging as a high-value fruit crop in India owing to its richness in nutritional profile, adaptability to diverse agro-climatic conditions and increasing consumer demand. Rich in dietary fibre, minerals and antioxidants such as betalains, it is increasingly recognised as a health promoting fruit. The crop requires relatively low water, tolerates low fertile soils and bears early, making it suitable for sustainable horticulture. With increasing production, value addition has become mandatory to enhance market demand and farmer's income. Research-led innovations such as Kamalam RTS, a ready-to-serve beverage with natural colour and prolonged shelf life, and dragon fruit powder with extended storage stability and diverse food applications, demonstrate the crop's processing potential. Overall, dragon fruit offers great potential for nutrition security, entrepreneurship and profitable diversification of farming systems in India.

Keywords: Betalains; Dietary fibre; Nutraceutical value; Pitaya; Value-addition

DRAGON fruit (*Selenicereus spp*), popularly known as Pitaya, is a climbing or sprawling cactus belonging to the family Cactaceae. It is a perennial, fast-growing plant with succulent, greenish, angular stems that develop aerial roots, enabling it to cling on the poles or other supports. A distinctive feature of Dragon fruit is its Crassulacean Acid Metabolism (CAM) pathway, in which stomata opens at night, reducing water loss. This adaptation makes the crop well suited to dry and semi-arid regions with limited water availability.

Dragon fruit originated in the tropical rainforests of Mexico and Central America. From its centre of origin, it spread to South America and later to Southeast Asian countries such as Vietnam, Thailand, Malaysia, and Philippines, where it received commercial importance due to its attractive fruits and gained strong market demand. Vietnam became a major producer and exporter, significantly contributing to its global

popularity. In India, Dragon fruit was introduced in the late 1990s and has gained rapid recognition since then its adaptability to diverse agro-climatic conditions, drought tolerance, suitability for problematic soils, and increasing consumer demand have supported the gradual expansion of cultivation across several states, establishing it as an emerging fruit crop of horticultural significance.

Dragon fruit (vernacularly called as Kamalam fruit) has emerged as a promising crop in India. Once limited to niche markets, now it is widely cultivated due to its great market value, adaptability to diverse agro-climatic conditions, and very less water requirement. Rich in dietary fibre, vitamins, minerals, and antioxidants, it appeals to health-conscious consumers.

Beyond nutrition, it offers vast potential for sustainable horticulture and income generation. It suits marginal farmers and supports value addition through processing of pulp, seeds, and peel. Thus,



Major Dragon Fruit production zones and Emerging States in India

kalamam fruit is emerging as a crop that can enhance nutrition security, farmer livelihoods, and sustainable agricultural development in India.

Nutraceutical value and health benefits: Dragon fruit, has established itself as a prominent tropical fruit owing to its balanced phytochemical profile and presence of health-promoting compounds. The fresh pulp contains about 82-85% moisture, making it light and easily digestible, while its less fat content and low energy value supports its adoption in health-oriented diets. The fruit provides moderate dietary fibre (0.8-1.0 g/100 g pulp), contributing to digestive health and glycemic control. It also supplies essential micronutrients, including vitamin C (6 mg/100 g) and important minerals such as potassium (120-200 mg/100 g), calcium (20-45 mg), magnesium (30-45 mg), phosphorus (20-35 mg), and iron (0.7-1.5 mg/100 g), enhancing its overall nutritional value.

Distinctive nutritional attribute of Dragon fruit is its richness in bioactive compounds, particularly betalains, phenolic compounds, and flavonoids, which together contribute to its strong antioxidant potential. Betalains, responsible for the characteristic red and pinkish red colour in red & purple fleshed Dragon fruit, are known for their antioxidant and anti-inflammatory potential. Phenolic content in Dragon fruit pulp has been reported to range between 25-55 mg GAE/100 g, while flavonoid content ranges from 15-35 mg CE/100 g. In addition, dragon fruit contains moderate levels of natural sugars (about 5-7 g/100 g pulp) and displays a low glycaemic index, making it suitable for diabetic and health-conscious consumers when consumed regularly. The collective presence of fibre, essential minerals, vitamin C, betalains, and antioxidants positions it as a nutritionally valuable fruit capable of supporting improved nutrition and overall health.

Important species and varieties under cultivation: Dragon fruit commercial cultivation worldwide is based on a only few species of the genus *Selenicereus* (formerly grouped under *Hylocereus*). The most widely grown species is *Selenicereus undatus*, which has a red or pink peel with white pulp. It is preferred for its wide adaptability, stable yield, and commercial success. The fruits are less sweet

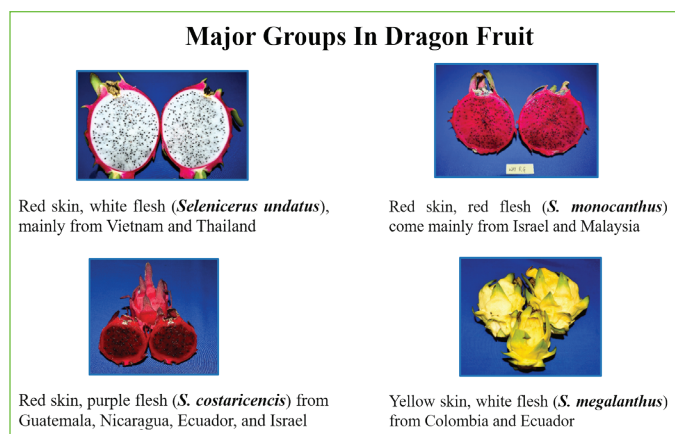
and suitable for fresh consumption as well as processing.

Red-fleshed types are mainly represented by *Selenicereus monacanthus* and *Selenicereus costaricensis*, producing red peel with red to reddish purple pulp. These types are gaining popularity because of their attractive colour and higher betalain content, contributing to higher antioxidant value and better market prices, particularly in urban and export markets. The yellow-skinned species, *Selenicereus megalanthus*, has limited occurrence in India because of slower growth and limited adaptability, although it has superior sweetness. In India, cultivation is largely focused on white- and red fleshed types, with growing interest in red- and purple-fleshed genotypes.

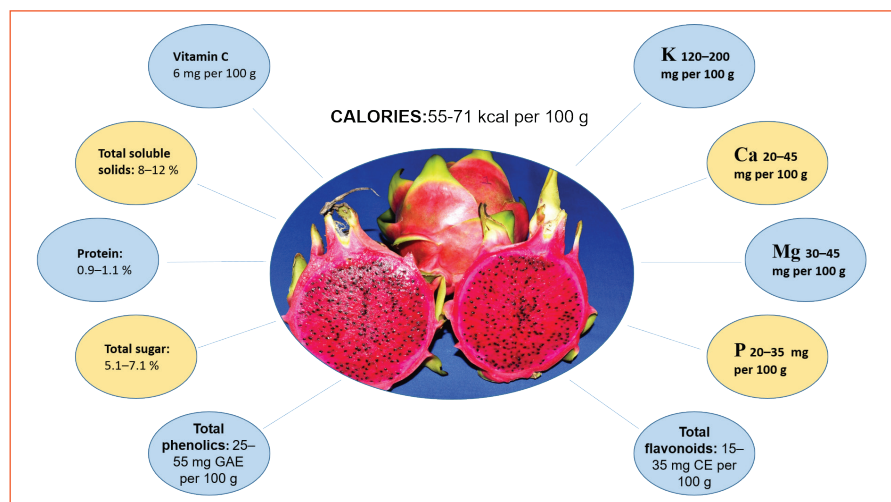
Several promising genotypes *CHES-D1*, *CHES-D2*, *CHES-D3*, *Hirehalli White*, and *CHES-DE* are under evaluation at the Centre of Excellence, Hirehalli, ICAR-Indian Institute of Horticultural Research. These are being analyzed for growth, yield, fruit quality, and adaptability, supporting the spread of region-specific, high-performing planting material in India.

Cultivation practices and agronomic advantages:

Dragon fruit cultivation is rapidly increasing in India due to its adaptability to diverse agro-climatic conditions. It performs well in tropical and subtropical regions and tolerates drought better than many fruit crops. It thrives in well-drained soils and can be grown successfully on



Different Species of Dragon fruit



Nutritive value of Dragon fruit

marginal or degraded lands, provided waterlogging is not a problem. The key agronomic advantage is its low water requirement. Because of its CAM pathway, the plant utilises water efficiently by reducing transpirational losses. This makes it suitable for drought prone areas. Drip irrigation is recommended to enhance water use efficiency, particularly during flowering and fruit development.

Plants are trained on concrete or wooden poles to promote vertical growth and facilitate better canopy management practices. Regular pruning improves light penetration, regulates vegetative growth, and enhances

flowering and yield. Removal of weak, diseased and overcrowded shoots ensures better plant health and productivity. Dragon fruit bears early, with flowering & fruiting starting 14–18 months after planting under good management. Multiple flowering flushes (generally 5-8, differ from species to species) enable staggered harvesting and continuous income. The crop has relatively low pest and disease incidence however in tropical region, ants and anthracnose are major problem. In addition to diseases fruit cracking is major physiological disorder. Proper management practices help in reducing these incidences.

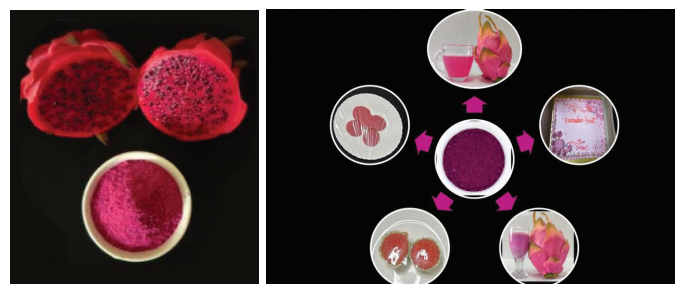
Overall, drought tolerance, Minimal input requirement, early and extended bearing, and wide adaptability make Dragon fruit a suitable crop for farming system diversification and sustainable income generation in India.

Value addition and product diversification in dragon fruit: Production of dragon fruit is steadily increasing in India, creating a strong need for development of value-added products to enhance demand, stabilise prices and improve farmer income. Value addition not only strengthens market potential but also ensures better utilisation of surplus produce and reduces post-harvest losses. In response to growing consumer preference for convenient and health-oriented beverages, ready-to-serve (RTS) fruit drinks are securing popularity as healthier alternatives to carbonated beverages.

In this direction, ICAR–Indian Institute of Horticultural Research (IIHR), Bengaluru, has developed Arka Kamalam RTS, a ready-to-serve beverage from Dragon fruit. Preparation of dragon fruit RTS is technically challenging due to the mucilaginous nature of the pulp. A standardised method has been developed to obtain clear juice without seeds, resulting in an attractive beverage with a natural pink colour and characteristic flavour without the addition of synthetic colours or

flavours. The RTS beverage has a shelf life of up to six months under optimum storage conditions and retains important phytochemical compounds such as ascorbic acid, total betalains and polyphenols known for their health-promoting properties.

In addition to beverages, Dragon fruit powder has been developed as a stable, value-added product with prolonged shelf life (approximately six months at room temperature and up to twelve months under refrigerated storage). The powder contains appreciable amounts of carbohydrates, dietary fibre and protein, along with significant levels of bioactive compounds such as anthocyanins (96 mg/100 g) and vitamin C (43 mg/100 g). It is also a source of essential minerals including calcium, potassium, magnesium, iron, zinc and manganese. Due to its intense natural pink colour and functional properties, Dragon fruit powder can be utilised as a natural food colourant and flavouring ingredient in bakery products, confectionery, milkshakes, ice cream and health formulations. The powder form facilitates easy transportation, storage and incorporation into various food matrices.



Dragon fruit powder

Processed products prepared from dragon fruit powder and pulp



Arka Kamalam RTS

Beyond edible applications, Dragon fruit fractions derived from the pulp and peel are now-a-days utilised in cosmetic products such as creams, soaps and lotions owing to their antioxidant-rich composition and skin-beneficial properties. Red- and purple-fleshed cultivars are highly suitable for such diversified processing due to their high pigment content, while the peel, often regarded as waste, can be effectively utilised for the extraction of natural pigments and antioxidants, thereby promoting sustainable processing and circular resource utilisation. Adoption of these value-added technologies by farmers, food processing industries, farmer-producer organisations (FPOs) and small-scale entrepreneurs can expand product portfolios, generate additional income and enhance the overall profitability and environmental stewardship of Dragon fruit cultivation in India.

SUMMARY

Dragon fruit has arisen as a promising fruit crop in India owing to its nutritional richness, adaptability to diverse agro-climatic conditions and increasing consumer demand. Its low water requirement, tolerance to problematic soils and early bearing habit make it suitable for sustainable and climate-resilient horticulture. Increasing awareness about functional foods has further enhanced the demand for red- and purple-fleshed types

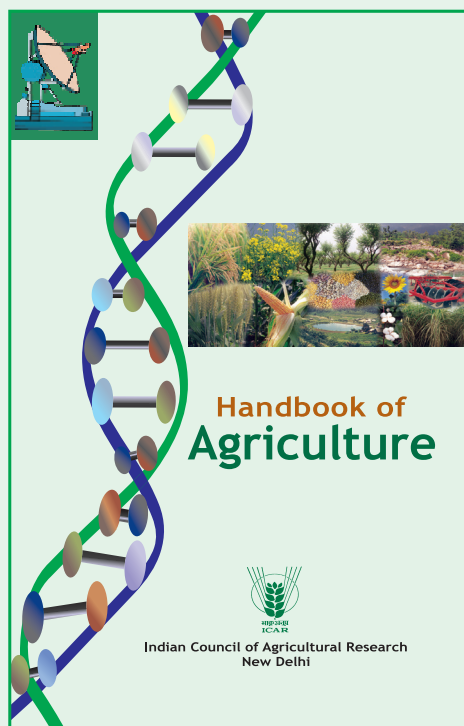
rich in natural antioxidants. With expanding cultivation, emphasis on scientific production practices, quality planting material and market-driven approaches will be essential to realise the full potential of the crop. Value addition and diversification of products can further improve Revenue generation and reduce post-harvest losses. Overall, dragon fruit offers significant opportunities for enhancing nutrition security, strengthening farmer

livelihoods and promoting sustainable diversification of farming systems in India.

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TECHNICAL SPECIFICATIONS

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