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Characterization of Novel (*Hylocereus Spp.)* Dragon Fruit and Their Applications: A Review

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ABSTRACT:

Dragon fruit is a nutritious and wonderful exotic fruit cultivated throughout the arid regions of the globe, particularly Asian countries. The fruit with an attractive shape and magnificent colour are refreshing with mouth-watering taste. It is abundant in vital nutritional ingredients viz. carotene, calcium, fibre, vitamin B, vitamin C, and phosphorous. Most importantly, being rich in various nutrients, vitamins and minerals and accordingly owing high medicinal values, it is believed to able to lower cholesterol concentration, to balance blood sugar concentration, to prevent colon cancer. Further, extraction and application of bioactive compounds from fruit waste having the application for food fortification can enhance the overall efficacy of the process. This review highlights the technologies and processes adopted for the overall utilization of dragon fruit. Further to make rational usage of this valuable resource, systematic compilation and presentation of reported literature are required.

Keywords:Dragon fruit, Morphology,Nutritive value, Medicinal value,Phyto-chemical constituents.

Introduction:

Herbal medicine has now become an integral part of standard healthcare, as they are used both traditionally as well as in ongoing scientific research. Herbal medicines are rich in natural substances that can promote health and reduce illness. The fruit *Hylocereus undatus* is also known as Dragon Fruit and Pitaya belonging to family Cactaceae. *Hylocereus undatus* fruit is commonly used as a food. It is a native fruit originating from Mexico and Central and South America. It has been cultivated in Vietnam for at least 100 years, following by the French(Bushan *et al*., 2020).

Hylocereus undatus - Greek word hyle (woody), the Latin word ***cereus*** (waxen) and the Latin word *undatus* - the wavy edges of its stems.It has vernacular names - Kamalam (Hindi), Thangloy (Vietnamese), Pitayaroja (Spanish), and La Pitahaya Rouge (French). There are three types of dragon fruit: ***Hylocereus undatus***-pink skin with white flesh, ***Hylocereus costaricencis***-violet red flesh with pink skin and ***Hylocereus megalanthus***-white flesh with yellow skin (Bushan *et al*., 2020).

History and status of dragon fruit:

Despite this contemporary global spread, Dragon fruit is native to Mexico, Central America, and South America and was introduced to Asia via Vietnam by the French in the early 1800s. In the United States, dragon fruit continues to gain popularity, which is spurring expansion in commercial production.Cultivation of dragon fruit wasstarted in KVK, Hirehalli of Tumkur district of Karnataka (Satish *et al*., 2019).

World production of Dragon fruit is estimated to 21, 00,777 MT, out of which 12,200 MT is contributed by India(1%) and stands ninth place in the world. Vietnam stands first place in the world which produces 10, 74,242 MT (43%) followed by China, Indonesia, Thailand and Taiwan. Gujarat state is the largest Dragon fruit producer in India (National Horticulture Board, 2020).

Description:

Pitaya cultivars and species are incompatible with one another. These magnificent, edible white blossoms are enormous, aromatic, nocturnal, bell-shaped, and can grow up to 36 inches long and 9 inches broad (23 cm). Cream-colored stamens and lobed stigmas. Three to five spherical buttons appear on the stem border, with two to three of them developing into flower buds in around 13 days. Anthesis happens when the bright green, cylindrical flower buds reach around 11 inches in length after 16-17 days.

The fruit is a fleshy berry that is rectangular in shape and about 4.5 inches (11 cm) thick, with a red or yellow skin/peel with scales and spines. Depending on the species, pulp might be pink, white, red, or magenta in color. The seeds are small, abundant, and black, and they are imbedded in the pulp.

Varieties of dragon fruit:

(a) **Hylocereus undatus**, often known as the white-fleshed pitaya, is a Cactaceae species that is the most widely grown in the genus. In cultivation, it can be found all over the tropics. The genus, like other true cacti, is native to the Americas, although the species' origin is unknown. The pitaya, or dragon fruit, is grown as a decorative vine as well as a fruit crop. The fruit is oblong to oval, 6–12 cm long, 4–9 cm thick, with white pulp and edible black seeds, and is red with huge bracteoles. The nectar-feeding bats Leptonycteris curasoae and Choeronycteris mexicana, which are the major pollinators of this species, are among the nocturnal visitors in Mexico. Bees arrive and pollinate flowers that are still open the next morning. Selfing and outcrossing produce fruit on this cactus, which has a mixed breeding system (Valiente-Banuet et al., 2007).

(b & c)Hylocereus costaricensis, known as the Costa Rican pitaya or Costa Rica night blooming cactus, is a cactus species native to Costa Rica and Nicaragua Flowers are funnel-shaped, 22–30 cm long, and have a strong perfume. Fruits are widely oval to globose, vivid red and purple in color due to the pigment anthocyanin, and seeds are pear-shaped, black, and 10mm in size

(d) **Hylocereus megalanthus** is a species of cactus in the genus Selenicereus native to northern South America, where it is known as pitaya, along with its fruit. Commercially produced for its golden fruit, this species is also a stunning ornamental climbing vine with some of the largest flowers of all cacti. Fruits are ovoid, tuberculate, spiny, with yellow skin and black seeds with white interiors (occasionally pink when hybridized). They are edible and have a nice, somewhat sweet flavor (Anderson et al., 2001).

Nutrient composition of dragon fruit:

Composition	White flesh dragon fruit	Red flesh dragon fruit
Energy(kcal)	130	283
Moisture	85	87
Protein(g)	0.5	0.2
Fat(g)	0.1	0.6
CHO(g)	9.5	11.2
Glucose(g)	5.5	4.7
Fructose(g)	1.9	1.8
Crude fiber(g)	1.1	1.3

Gunasena et al., 2006

Seeds: Black, tiny seeds are imbedded in the white or pink flesh of dragon fruit. The oil produced from these dragon fruit seeds has been studied in order to establish its makeup. The oil extract of these seeds was discovered to be rich in 50% essential fatty acids, especially linoleic acid and linolenic acid, which are needed in human metabolism and cannot be produced by the human body from other food components. Several studies have found that the flesh of dragon fruits is high in polysaccharides (Xu et al., 2016) and mixed oligosaccharides (Wichienchot et al., 2010), both of which have been shown to stimulate the growth of Lactobacilli and Bifidobacteria. Lactobacilli and Bifidobacteria are Gram-positive lactic acid-producing bacteria that make up a large part of the human gut microflora. Probiotics are gastrointestinal microfloras that help to decrease the growth of gastrointestinal infections. The following are the fatty acid compositions of two pitaya seed oils: (Ariffin et al., 2009).

Fatty acid composition of two pitaya oil seeds:

Fatty acids	*Hylocereus costaricensis* (Red-fleshed pitaya)	*Hylocereus undatus* (White-fleshed pitaya)
Myristic acid	0.2%	0.3%
Palmitic acid	17.9%	17.1%
Stearic acid	5.49%	4.37%
Oleic acid	21.6%	23.8%
Cis-vaccenic acid	3.14%	2.81%
Linoleic acid	49.6%	50.1%
Linolenic acid	1.21%	0.98%

Phytochemistry: Vitamin B1, vitamin B2, vitamin B3, and vitamin C, as well as protein, fat, carbohydrate, crude fiber, flavonoid, thiamin, niacin, pyridoxine, kobalamin, glucose, phenolic, betacyanins, polyphenol, carotene, phosphorus, iron, and phytoalbumin, are abundant in Hylocereus undatus. It's high in phytoalbumins, which are known for their antioxidant effects.

Neutraceutical activities:

Antioxidant activity: Because the peel contains more flavonoids than the meat, ethanol extracts of the H. undatus peel and flesh were postulated to have distinct antioxidant capabilities.The presence of ascorbic acid in dragon fruit contributes to its antioxidant properties (Vitamin C). Ascorbic acid serves a variety of physiological activities in living creatures, including acting as a reductant to protect cellular components from oxidative damage. This is because ascorbic acid can act as a scavenger for free radicals and oxygen-derived species such as singlet oxygen, hydrogen peroxide, and hydroxyl radicals during their oxidation. As a result, ascorbic acid has been discovered to be quite beneficial in the treatment of photo-aging. Instead, ascorbic acid's antibacterial actions are aided by its pro-oxidant capabilities.

Anticancer activity: Polyphenols, flavonoids, and betanins found in Hylocereus undatuslike lycopene have anticancer properties, according to several studies. Anti-proliferative action was observed in H. undatus peel extracted with an ethanol-water (50:50, v/v) solvent solution.

Hypocholesterolemic Effect: PUFAs found in the flesh of H. polyrhizus were able to lower cholesterol levels in the body, such as V-LDL and RLP. Polyphenol content in H. polyrhizus meat also has anti-thrombotic effects, enhancing its cardio-protective qualities.

Prebiotic Effect: About 85 percent of mixed oligosaccharides were found in the ethanol extract of H. undatus meat. In comparison to inulin, these oligosaccharides demonstrated a greater resistance to human salivary - amylase. This is not digested in the stomach, but it acts as a prebiotic, promoting the growth of good bacteria such as lactobacilli and bifidobacteria. These microbes will aid digestion and maintain a healthy immune system (Pandya et al., 2019).

Dragon fruit pulp extraction:

Take a clean, ripe dragon fruit that has been rinsed in drinkable water. The peel is then peeled away, and the meat or edible component is removed. The edible part is sliced into 1/4-inch (0.5-0.6cm) slices. The slices were then smashed to extract pulp. That pulp is kept at a 4℃ chilled temperature (Kirtiet al.,2020).

Dragon fruit juice preparation:

It is taken ripe dragon fruit that has been well cleaned and rinsed with drinkable water. The skin of the fruit is then peeled and the meat separated with a peel remover. The juice is extracted and pasteurized at 72℃/15S before being chilled to 30℃. It's been treated with pectin ultra SP-L enzyme, which helps to boost juice yield, stability, and clarity by decomposing soluble pectin and starches, which cause haziness in juice. Finally, the juice is bottled and kept at 4℃ (Kirtiet al., 2020).

Products made from dragon fruit in the dairy and food industries:

Ice cream with dragon fruit:

Peeling or scooping out the fruity flesh separated the pitaya pulp from the skin. To get a homogeneous mixture, they were cut into 1x1cm little pieces and mixed for 2 minutes. By combining fresh milk, whipping cream, and sugar, and then adding egg yolk and beating to obtain a homogenized liquid mixture, three different ice cream formulas were created. For aging, the ice cream mix was refrigerated at 4℃ for 4-6 hours, then stabilizer was added and beating continued to incorporate air. The finished product was poured into small cups (150mL) and kept frozen (-24℃) until use.

Ice cream is made without the addition of dragon fruit pulp as a control, and then dragon fruit pulp is added at rates of 12, 15, and 18 percent, respectively, and ice cream is made, with the influence on sensory characteristics of dragon fruit ice cream being evaluated. The viability of a worthwhile business producing ice cream utilizing 12 percent pitaya fruit pulp with increased acceptability to meet market needs was determined by the study (Perera et al., 2013)

Dragon fruit (Hylocereus costariscensis) wine development:

A total of four kilos of dragon fruits were utilized in each treatment. Fruits were washed and drained in stackable plastic baskets under running water. The pulp was diluted with water at a ratio of 1:2 pulp to water before blending. The pulp was mixed until it formed a homogenous mixture. Allowing the prepared must to sit for 30 minutes allowed the pulp to float on top of the juice.

By scooping and separating the pulp, the juice was removed. According to the treatments, sugar was added to the extracted juice. To sterilize the mixture, five millilitres of 10% sodium metabisulfate per gallon of must were added, with a 24-hour holding time. According to the treatments, dryyeastSaccharomyces cerevisiae was introduced. Must was fermented for 24 hours using a cotton plug cap to allow yeast to incubate and multiply. Fermentation locks were then used to secure the fermentation bottles. Fermentation was allowed to continue for 3-4 weeks, or until no more gas was produced.

A system was devised for the manufacturing of appropriate dragon fruit wine. In order to make an acceptable semi-sweet dragon fruit wine, the initial sugar content of the fermenting must must be 250g, and 2 table spoon yeast per kg of fruit must be used. In order to make acceptable sweet dragon fruit wine, 500 g sugar and 2 table spoon yeast must be used (Dimeroet al., 2018).

Conclusion:

With dozens of options available at the grocery store, this exotic fruit may be one of the greatest options! Its advantages are nearly limitless, including improved heart health, easier weight management, and even aid in the management of diseases like asthma and diabetes. Dragon fruit is a new fruit crop in nations such as India, and its production area is expanding. Although fresh fruit is now only available during specific seasons and in limited areas, the potential for domestic and international marketing is enormous. Pitaya can assist to reduce the risk of chronic diseases because to its nutritional and functional qualities.

It contains phytochemicals, antioxidants such as flavonoids, phenolic acid, and betacyanin, all of which have medicinal potential. To promote human health, dairy and food products must be incorporated. Commercialization requires the development of new food products as well as increased awareness.

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