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A REVIEW LITERATURE ON HYLOCERUS POLYRHIZUS (DRAGON FRUIT)

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ABSTRACT

Dragon fruit (*Hylocereus polyrhizus*) or pitaya is an exotic tropical plant that belongs to the family of *Cactaceae*. Dragon fruit is gaining popularity in the market for consumption of fresh fruit due to its highly attractive fruit colour with nutritional and immense bioactive potential that reduces blood sugar levels, cholesterol, prevention of liver injuries, cancer, etc. It became an interesting subject for many researchers mainly due to its unique taste, shape and the flesh colour. Dragon fruit own a range of beneficial biological activities against pathogenic microbes including bacteria, fungi and viruses, and diseases like diabetes, obesity, hyperlipidaemia and cancer. This article reports about a complete data on pharmacognostic studies, traditional uses, Nutrient value phytochemistry studies, pharmacological studies till date. The red variety of dragon fruit has many pharmacological uses like anticancer, antioxidant, antiulcer, etc. which will be detailly revealed.

KEYWORDS: Hylocereus polyrhizus, tropical fruit, peel, phytochemistry, antioxidant, pharmacological studies.

INTRODUCTION

Dragon fruit (*Hylocereus polyrhizus*) or red pitaya is one of the awe-inspiring tropical fruits that belongs to the family of Cactaceae. Pitaya is native to the tropical areas of Mexico, north

central and south America, it is now cultivated worldwide due to its commercial interest. Dragon fruits have been classified based on the colour of flesh and peel, *Hylocereus undatus* variety has white flesh with pink skin known as white dragon fruit, flesh of *Hylocereus polyrhizus* was red in colour with pink skin known as red pitaya. And *Hylocereus megalanthus* with white pulp and yellow skin know as yellow pitaya. Especially red pitaya *(Hylocereus polyrhizus*) cultivated in Malaysia, Thailand, Vietnam, Australia, Tiwan, and some other parts of world.

The fruit of red pitaya (*Hylocereus polyrhizus*) is oval shape, large in size, weighing about 135-350gm, 10-12cm in size. The fruit has delicate and sweet flesh with intense red purple colour of the flesh and peel. It has a lot of small black seeds which are rich in essential fatty acids. The fruits often consumed fresh or by making into juices, cordial, jams and ice cream by processing it. The pigment that is responsible for the red colour of the fruit is Betacyanin.

Dragon fruit peel (DFP) which accounts for more than 20% by weight of the whole fresh fruit, is usually discarded as waste during processing.

It is also rich in nutrients and minerals, including vitamin c, B1, B3, dietary fibres, making addition to a health-conscious diet.

The peel contains betasianin, flavonoids, and phenol. In addition, dragon fruit skin also contains vitamin C, vitamin E, vitamin A, terpenoids, flavonoids, thiamine, niacin, pyridoxine, cobalamin, phenolic, carotene, and phytoalbumin which are thought to have antioxidant benefits and can also bepotential for antimicrobial activities.

In addition, the colourful of plants have become attention of man throughout history for art as well as for food colouring such as *anthocyanins, betalains, carotenoids, and chlorophylls*.

The peels are mostly waste materials resulting from the dragon fruit juice processing industry and are normally discarded. Thus, in addition to being fed to animals, the peels can be used in the production of pectin, which would then increase the potential return for the dragon fruit juice processing industry. Pectin is widely used in the food industry as a thickener, emulsifier, texturizer and stabilizer. Pectin is usually added in jams and jellies as a gelling agent. It has also been used as a fat substitute in spreads, ice-cream and salad dressings. In terms of nutrition, pectin has been shown to lower blood cholesterol levels and low-density lipoprotein

cholesterol fractions, which is beneficial for human health. According to the FAO, pectin is considered to be a safe additive that can be taken daily without limits.

The 3 varieties of pitaya

1. White-fleshed pitaya with yellow peel (*Selenicereus megalathus*),

2. White-fleshed pitaya with red peel (*Hylocereus undatus*)

3. Red-fleshed pitaya with red peel (*Hylocereus polyrhizus*)

BOTANICAL/SCIENTIFIC CLASSIFICATION

Kingdom: Plantae

Division: Magnoliophyte (Flowering plant)

Class: Liliopsida (Monocotyledons)

Sub-order: Caryophyllidae

Order: Caryophyllales

Family: *Cact*aceae

Sub- family: Cactoideae

Genus: *Hylocereus*

Species: *polyrhizus*

TRADITIONAL USES

Pitaya has been used as a traditional medication and consumption purposes in central America, where it is also common for pitayas to be grown in family gardens. The leaves and flowers of pitaya were used by the ancient Mayas for the medicinal use as a diuretic and healing agent. Mayas also utilizes the pitaya fruits as a diuretic, hypoglycaemic, against heart disease, wound disinfectant, and tumour dissolution, and as a cure for dysentery. In addition, the flowers can be consumed as it is or by drinking it as a tea, the seeds possess a laxative effect, the fruit has shown an effect on gastritis, and the stalk can also be used for kidney problems.

MEDICINAL VALUES

Consumption of fruits and vegetables is necessary to prevent various diseases. This is in line with an epidemiological study in 1992 which stated that the potential for cancer in the population would be lower when the population regularly consumed fruits and vegetables. Phytochemicals are chemicals that play a biologically active role in fruits and vegetables.

One of the fresh fruits that is in great demand by the world's population is dragon fruit. One of the dragon fruit species known for its phytochemical content is the red dragon fruit *(Hylocerus polyrhizus*). Red dragon fruit contains minerals and nutrients such as Vit-B2, B3, B1 and C, fat, carbohydrates, protein, betacyanin, polyphenols, iron, Phyto albumin, carotene, cobalamin, glucose, and phenolic. With various nutrients and minerals available, red dragon fruit has a positive effect in helping the digestive process, there are anti-diabetic, lowers blood pressure, neutralize toxins in the body, especially toxins from heavy metals, helps treat asthma as well as coughs and prevents various types of cancer especially colon cancer.

Dragon fruit prevention of cancer is played by the content of Phyto albumin which has a very high antioxidant content. Iron content is also found in red dragon fruit, and iron is able increase erythrocyte and haemoglobin levels so that it can be used as an anaemia treatment, but research on anaemia treatment from dragon fruit is still in a trial using rats.

Dragon fruit pulp contains flavonoids ranging from (7.21±0.02mg vs. 8.33±0.11mg of catechin equivalents/100 g of flesh and peel matters) and phenolic content of [42.4±0.04mg of gallic acid equivalents (GAE)/100 g of flesh fresh weight] and peel (39.7±5.39 mg of GAE/100 g of peel fresh weight. Both phytochemicals content is very good for the body, especially as antioxidants that can act as cancer and cardiovascular disease prevention agents.

Apart from polyphenols and flavonoids, there are other phytochemicals called betacyanins and betaxanthins which are part of betalains. Studies show that the betacyanins in dragon fruit have free radicals neutralising property.

NUTRIENT VALUE

The results of the nutritional analysis showed that the average pitaya contains:

Type of nutrient	Amount
1. Moisture	84-86 g/100 g
2. Protein	0.93-1.33g/100 g
3. Fat	0.40-1.01g/100 g
4. Vitamin C	1.0-6.3mg/100 g
5. Vitamin A	0.0066-0.186 mg/100 g
6. Ash	0.56 g/100 g
7. Crude fibre	0.88-1.84 g/100 g
8. Glucose	4.63-6.39 g/100 g
9. Fructose	2.16-4.0 6 g/100 g
10. Sorbitol	0.33 g /100 g
11. Carbohydrates	10.4-12.3 g/100 g
12. Iron	1.95-7.4 mg /100 g
13. Potassium	181.0-321.0 mg/100 g
14. Niacin	2.3-3.5 mg/100 g
15. Calcium	7.6-15.6 mg/100 g
16. Magnesium	29.5-44.3 mg/100 g
17. Phosphorus	22.8-31.8 mg/100 g
18. Sodium	5.0-13.5 mg/100 g
19. Zinc	0.26-0.42 mg/100 g

PHARMACOGNOSTIC STUDIES

Synonym: Selenicereus monacanthus, red pitaya, pitahaya.

Biological source: *Hylocerus polyrhizus* (*weber*) is native to Mexico belongs to *Cactaceae* family.

Geographical source: *Hylocerus polyrhizus* is an exotic fruit grown in tropical and subtropical region of Mexico, but now cultivated worldwide which includes Vietnam, Taiwan, southern China, Israel, and recently in Thailand, Australia, united states, and Malaysia.

In India, dragon fruit is cultivated in Karnataka, Kerala, Tamil Nadu, Maharashtra, Gujarat, Orissa, west Bengal, Andhra Pradesh, and Andaman and Nicobar Islands.

Cultivation

Tropical climatic region is best for its cultivation. The fruit can be grown in wide range of soils from sandy loam to clay loam. This fruit plant survives in poor soil condition and temperature variations about (20^0C-30^0C). However, sandy soils with good organic matter and internal drainage, are best for its cultivation. Soil pH of 5.5-7.0 is the best for dragon fruit cultivation. This plant requires minimum annual rainfall of 50 cm.

The most common propagation method in dragon fruit cultivation is by cutting and also by seeds. But seeds take longer time and will not continue with mother plant characteristics. This method is not suitable for commercial cultivation. About 20 cm length cuttings, from a quality mother plant should be used for planting. Pile these cuttings a day before potting.

Scenario of dragon fruit cultivation in India

Whereas about India, It was newly introduced fruit after 1990s and area underneath an expansion of agricultural production is in developing state. Presently some parts of Indian states such as Maharashtra, Karnataka west Bengal, Tamil nadu, Kerala, Gujarat, Andaman and Nicobar Islands, Orissa, and Andhra Pradesh are cultivating DF but production is not full filling the market demand in India. Dragon fruit is a semi epiphytic wine plant which can climb naturally to any natural / artificial support they meet due to the presence of aerial roots. Growing them flat on the ground is not recommended, firstly due to it makes cultivation more difficult. Proning is important for the plant to climb over the entire support. Major proning is carried out the first year after planting. It includes removing all-damaged stems. Postharvest proning encourages the growth of new young shoots that will bear flowers of the following year.

Collection

The plant start yielding after 12-15 months from the date of planting and the fruit epicarp colour from green to red. Proper time of harvesting was found after seven days of colour transition. The plants yield the fruits in the months between June – September and harvest could be done 3-4 times in a month. Present farm gate price ranged between INR 80.00-120.00 per kg.

Characteristics

Red-fleshed dragon fruit is an oblong-shaped berry that is Medium to large in size with a scaly pink peel.

Chemical constituents

Fruit contains various phytochemicals such as *Flavonoids, Betacyanin (responsible for red or purple colour), Polyphenols, Carotenoids and Vitamin C.*

β-amyrin (15.87%), α-amyrin (13.90%), octacosane (12.2%), γ-sitosterol (9.35%), octadecane (6.27%), 1-tetracosonal (5.19%), Stigmast-4-en-3-one (4.65%), and Campestrol (4.16%).

PHYTOCHEMISTRY

Initial phytochemical examination showed that the methanol and water extract of pitaya or dragon fruit seeds contained alkaloids, saponins, terpenoids, oils, flavonoids, tannins, phenols, carbohydrates, coumarins, and proteins. Pitaya contains proteins, steroids, carbohydrates, alkaloids, tannins, flavonoids, and phenolic compounds. Alkaloids that are present are cholinesterase inhibitors that can be used for Alzheimer's disease treatment like donepezil, tacrine, rivastigmine, and velnacrine. Coumarins that are present in both extracts like phenylpropanoids are antioxidant, anti-bacterial, anti-tubercular, anti-fungal, anti-viral, and anti-inflammatory, Reno-protection, anti-atherosclerosis, immunomodulatory, hepato-protective effect. Saponins include lupane glycine, betulinic acid, and oleanolic acid can be used to treat type-2 diabetes and also chronic kidney disease. The oil of pitaya seeds contains omega-3 fatty acids, conjugated linoleic acids, phytosterols, and medium chain triglycerides that are beneficial in treating obesity and bone health. Both condensed tannins such as proanthocyanidins and anthocyanidins and hydrolysable tannins like Gallo tannins and ellagitannins are present, with polyphenols being present in the peel. Pitaya peels contain higher amounts of flavonoids that have metal chelating and radical scavenging properties

such as kaempferol, isorhamnetin, quercetin, and kaempferol. Dragon fruit phytoconstituents consist of oleic acid, 1-tetracosanol, trichloroacetic acid, hexadecyl ester, octacosane, 1-hexadecyne, 2-chloroethyl linoleate, phthalic acid, 6-ethyloct-3yl-2-ethylhexyl ester, 6-tetradecanesulfonic acid, butyl ester, tetratriacontane, heptacosane, n-hexadecanoic acid, 1,2-benzenedicarboxylic acid, mono (2ethylhexyl) ester, (Z,Z)-9, 12-octadecadienoic acid,17-pentatriacontene, eicosane, y-sitosterol. Pectin is the methylated ester of polygalacturonic acid that contains 1,4-linked α-D-galacturonic acid residues (Levigne et al. 2002). It is commonly found in the cell walls and middle lamellae of higher plants. These polysaccharides consist of 300-1,000 chains of galacturonic acid units.

PHARAMCOLOGICAL STUDIES

In the treatment of different diseases, medicinal herbal plants have demonstrated pharmacological activity, dragon fruit have many pharmacological activities listed below:

Antimicrobial activity

White dragon fruit flesh ethanolic extract was detected as around 85% of mixed oligosaccharides occur. In contrast to inulin, these oligosaccharides had greater tolerance to human salivary α-amylase. This is not digested in the stomach, but functions as prebiotics that help the stomach. *Bifidobacteria* and *Lactobacilli*, which are healthy bacteria, are increasing. Acetone extracts (70 % concentration) of *Hylocereus* peel have high antimicrobial activity, particularly against *Salmonella typhi*.

From the disc diffusion analysis, the antibacterial activity of chloroform, hexane extract, and ethanol from the skin of white dragon fruit revealed that the inhibition region of about 7 to 9 mm was able to combat Gram-negative and Gram-positive bacteria. Using the micro titre process, anti-bacterial analysis was performed. It was the minimum inhibitory concentration (MIC) of the bacterial species *E. coli* and *Staphylococcus aureus* was found to be 50µl.

Antifungal activity

The presence of polyphenol antifungal activity in extracts and fractions of flesh and peels of red pitaya fruits are two yeasts, *Candida albicans*, *Rhizoctonia solani*; four molds: *Aspergillus flavus, Fusarium oxysporum, Botrytis cinerea, Cladosporium herbarum* which is the research panel that include laboratory control strains obtained from the American Type Culture Collection (ATCC).

Anti-inflammatory activity

Anti-inflammatory action has been performed on dragon fruit. The research was carried out by mixing dragon fruit skin and flesh and separating it with vacuum distilled water, water, and drying. Then the results of this will be used for the purposes of bioassay testing against Cyclooxygenase-2 (COX-2), Acetylcholinesterase Enzymes (AChE), and 5-Lipoxygenase (5-Lipox). The results of these studies have shown that extracts derived from dragon fruit flesh showed excellent results against the three enzymes in the bioassay test and showed a stronger inhibitory power on the Acetylcholinesterase enzyme compared to other enzymes. This has shown that dragon fruit has the ability to relieve inflammatory symptoms, it can be seen from the mechanism that is directly related to cholinergic anti-inflammatory. In addition, the results shown by dragon fruit flesh on COX and Lipox enzymes also have an indication of a high potency that can cause blockages in the leukotriene and prostaglandin pathways. This shows that there are anti-inflammatory properties in the properties of dragon fruit. Extract from ethanol from red dragon fruit peel contains betalain which has the ability to inhibit the transcription factor NF-κB which will result in inflammatory genes such as TNF-α and IL-1β that will not be separated.

Anti-cancer activity

Various studies have shown that the flavonoids, betanin, and polyphenols in dragon fruit have an anticancer effect. The skin of dragon fruit that has been extracted with a mixture of water and ethanol solvent with a ratio of 50:50 has shown antiproliferative activity against human hepatocellular carcinoma cells in just one dose. Anticancer activity which is really precise is still being studied and cannot be known factually, however, previous research has resulted in the fact that the effect of polyphenol anticancer in dragon fruit may be mediated through factor suppression on nucleic-kappa B and by a mediated pathway. growth factor receptors, antioxidant mechanisms, anti-inflammatory, angiogenesis inhibition, cell cycle arrest and apoptosis induction, and protein kinase activation.

The red-fleshed contain lycopene, that is a natural antioxidant recognised to combat cancer. Antioxidants will protect cells from reactive oxygen species that can cause damaging effects and preventing any cancer-causing free radical formation. Red pitaya flesh and peel rich in polyphenols and good source of antioxidants. Research also shows that white dragon fruit is rich in flavonoids.

Antiulcer activity

The topical quercetin content in the skin of red dragon fruit *(Hylocereus polyrhizus)* shows antiulcer activity. It can be proven from the results of total distress in 35% of cases within 2 to 4 days and in 90% of cases within 4 to 7 days. Quercetin is useful for reducing the frequency of relapses and relieving mild symptoms.

Antidiabetic activity

There are several leaves and fruits that have the potential to be anti-diabetic, such as dragon fruit. Several studies have shown that dragon fruit has an antidiabetic activity effect. For patients with Type II Diabetes, the use of red dragon fruit can reduce blood glucose levels. The substance that lowers blood sugar levels in red dragon fruit is glucose.

In addition to glucose, dietary fibre in dragon fruit has a function to reduce the intensity of decreasing food in the intestines, thereby reducing the formation of blood glucose. The use of dried dragon fruit also has specific results as an herb for antidiabetic activity. This is also because dragon fruit dry has a blood sugar-lowering effect that can lead to diabetes.

For antidiabetic activity, the use of dragon fruit is not only fixed on dragon fruit flesh. Dragon fruit seeds and skin also have an antidiabetic effect. Dragon fruit seeds contain saponins that are soluble in water extracts and are useful as an antidiabetic substance, especially for people with type II diabetes. Meanwhile, dragon fruit skin contains soluble fibres that are believed to be able to regulate blood sugar levels in the body.

Diabetics will generally have wound that are difficult to heal. However, in one study, it was found that the use of *Hylocereus undatus* or white dragon fruit had the effect of accelerating the recovery process. The most effective white dragon fruit preparations used for wound healing in diabetics are topical preparations derived from flower or leaf water extracts. The use of white dragon fruit in the wound healing process in diabetics occurs due to the presence of DNA collagen content, increased epithelialization and Hydroxyproline, tensile strength and total protein.

Antioxidant activity

Pitaya is considered as a fruit that is low in calories but high in nutrition, water content, sugars, minerals, and antioxidants. *H. polyrhizus* or known as the red fleshed pitaya is rich in betalains which meets the trade interest for antioxidant products and also natural food

colorant. Pitaya seed oil holds a high potential as a source for natural antioxidants. Pitaya contains an abundance of Phyto albumins known for its antioxidant properties, not just Phyto albumins, the pulp and peel also rich in polyphenols. Through the study from the ethanolic extract of both the peel and the flesh of *H. undatus*, it is shown that the peel contains more flavonoids than the flesh. The pulp of pitaya can be added to yogurt to improve the antioxidant activity.

Anti-infertility activity

An experiment showed that dragon fruit extract can maintain sperm motility and improve testicular histology. white dragon which contains gallic acid as an antioxidant which tends to increase spermatozoa quality in the form of increased motility, number, and morphology of spermatozoa in the epididymis.

Antiplatelet activity

Dragon fruit has antiplatelet activity because it contains ethanol and ethyl acetate extracts which have inhibitory effects in concentration-dependent manner on platelet aggregations induced by various agonists.

Hepatoprotective activity

The extracts of dragon fruit do have a beneficial effect on poisoned rats. Due to its high antioxidant components coming from the above-mentioned intake of CCl_4. In specific, triterpenes and flavonoids are phytochemical components that defend the liver against fat peroxidation, but with a subsequent improvement in Serum Glutamic-Pyruvic Transaminase (SGPT) and Serum Glutamic-Oxaloacetic Transaminase (SGOT), the silymarin capsule has little preventive function against liver injury. The extracts of dragon fruit are effective in protecting the liver from it has been shown to test animals against persistent damage when induced with CCl_4.

Cardio protective activity

The effectiveness of polyphenols in flesh owned by *H. polyrhizus* is Anti-thrombotic effect, which increases its cardio protective properties further. In one study, rats were given two thermal processing methods for this dragon fruit were selected. The results of the analysis were that the cardio protective substances of red pitaya will be polyphenols and antioxidant material.

Neuroprotective activity

As mentioned previously, dragon fruit has a myriad of benefits and one of them is related to the neuroprotective activity of nerve work. The phytochemical content in dragon fruit plays an active role in neuroprotective activity, especially when preventing neurodegenerative diseases. The phytochemical content in dragon fruit which has the potential to prevent neurodegenerative diseases while also playing an active role in neuroprotector activity is essential fatty acids.

Cytoprotective activity

Pitaya is a great source of various for natural antioxidants, including ascorbic acid, betalains, and polyphenols. As a Fiber-rich Dragon fruit, it helps in food digestion. Soluble fibres found in pitaya peel may help neutralize dangerous substances such as heavy metals in the digestive process and may be associated with blood sugar control in people with type II diabetes. Pitaya peel also has mucilage that can have a beneficial effect on the metabolism of cholesterol.

Hypolipidemic activity

Dragon fruit flesh extract was used to determine hypolipidemic activity in rats. The extract of dragon fruit flesh could minimize TG, total cholesterol, LDL, and total cholesterol ratio over HDL cholesterol, body weight, Lee index obesity, and could also substantially raise serum HDL cholesterol, total faecal cholesterol, and fat. From this study, it was shown that dragon fruit flesh extract had biological activities of anti-obesity and hypolipidemic which could prevent atherosclerosis. Dragon fruit flesh extract consumption may not only bind cholesterol and fat from the feed but also increases the amount of cholesterol and fat in the feces.

Analgesic activity

Pitaya, like many other plants, contains gallic acid (3,4,5-trihydroxybenzoic acid), an organic substance that exists in plant materials that acts as antioxidant, antibacterial, antiviral, and analgesic activities.

CONCLUSION

Due to its nutritional and medicinal properties dragon fruit brings numerous benefits to human health mostly for the control and management of the oxidative stress. All the different types of pitaya (i.e., spines, peels and pulp) contain bioactive compounds involved in a wide range of beneficial biological activities including antioxidants, antimicrobial, anticancer, anti-

inflammatory capacities these include betalains, flavonoids, polyphenols, terpenoid and steroids, saponins, alkaloids, tannins and carotenoids, which has been proven as effective, healthier, safer and sustainable alternatives to synthetic drugs for the treatment and prevention of many diseases such as diabetes, cancer, obesity, hyperlipidaemia and pathogenic agents such as virus, bacteria and fungi. Besides the pharmaceutical value of its compound the pitaya is also a national suit of colours with potential uses in the food and cosmetic industries.

Few reports on dragon fruit peel available in literature all the majority type of compounds concentrated on phenolic compounds and presence and estimation. Isolation and characterization of colouring agents like betacyanins and anthocyanins. We like to explore a detail preliminary phytochemical compounds present in pitaya fruit peels (Hylocereus polyrhizus).

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