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Selenicereus undantus: a review of contemprory literature and medicinal properties

Author – Aishwarya Pawar, Dr.P.B. Ghogare

S.M.B.T COLLEGE OF PHARMACY, DHAMANGAON, NASHIK.422402

ABSTRACT:

The pitaya (Hylocereus), which is cultivated all over the world and is the most economically significant fleshy fruit tree in the Cactaceae family, has drawn considerable interest due to the abundance of betalain in its fruits. Pitaya, also known as dragon fruit, is an exotic tropical fruit that provides a number of health benefits for people owing to its high nutritional value and bioactive constituents, which include potent antioxidants. For the treatment of ailments including diabetes, obesity, dyslipidemia, and cancer, extracts from the stems, blossoms, peels, and pulp of dragon fruit have a variety of protective biological actions against pathogenic microbes, including bacteria, fungi, and viruses. Additionally, dragon fruit extracts have hepatoprotective, cardiovascular, and prebiotic efficacy. Due to their high adaptability and endurance to a wide range of environmental circumstances, pitaya plantations can grow in Vietnam thanks to the country's tropical climate (e.g. salinity adaptation, favour light intensity, drought resistance, etc.). The dragon fruit is utilised both as an ornamental climber and as a fruit crop known as the Pitaya or Dragon fruit. It offers a wide range of nutritional characteristics, biological activity, and commercial value and has become a cost-effective commodity for the national economy. Although it originated in Central America, it is now grown all over the world, particularly in subtropical regions. It is a quickly expanding climbing plant that needs a vertical support pole to grow on before a ring falls like an umbrella.

Keywords: botanical specification, pitaya, nutritive value, pharmacological aspects.

INTRODUCTION

Both mainstream treatment and current scientific study use herbal remedies, which are becoming an essential component of health care standards. Natural ingredients that can improve health and treat illness abound in herbal medications. The pitaya is a type of columnar cactus. The Cactaceae family includes the pitaya fruit, sometimes referred to as dragon fruit. The non-climacteric pitaya (Hylocereus undatus), sometimes known as "dragon fruit," is a cactus species. Worldwide, the pitaya fruit is frequently utilised in nutraceuticals. It is a natural fruit that comes from Central and South America, as well as Mexico. It has been grown in Vietnam for at least

100 years, with the French following [1]. The pitaya is an economically important fruit that is produced in over 20 tropical and subtropical countries, including the Bahamas, Bermuda, Indonesia, Colombia, Israel, Philippines, Myanmar, Malaysia, Mexico, Nicaragua, northern Australia, Okinawa (Japan), Sri Lanka, southern China, southern Florida, Taiwan, Thailand, Vietnam, Bangladesh, and the West Indies, commercially cultivate the pitaya fruit. Traditional and current scientific studies both employ herbal remedies as a standard component of healthcare [2].

In Asian nations, where traditional healers utilise herbal medicines to both prevent and treat illnesses, pitaya fruit is also regarded as a medicinal plant used in folk medicine. The pulp and peels are packed with fibre, have a highwater content, and are packed with nutrients like lots of vitamins, minerals, and antioxidants. The biological activity of dragon fruit has been investigated and demonstrated in a number of studies in recent years. The dragon fruit, also known as pitaya, is a species of plant that is anticipated to treat a variety of illnesses since it is rich in bioactive components (*Hylocereus sp.).* The majority of the Cactaceae family's plants live in deserts and semi-deserts, where they are frequently subjected to extreme environmental stressors such water scarcity, radiation exposure, temperature fluctuations, and Poor soil) are thought to have evolved highly powerful defence mechanisms, enabling them to successfully adapt with the environment. systems are composed of phytochemicals including alkaloids, flavonoids, terpenes, and tannins that have already been demonstrated to have amazing bioactivities against human diseases like cancer and diabetes. Herbs and medicines derived from plants are more appealing for treating cancer and for long-term preventive measures since they lack a lot of the toxicity found in synthetic chemicals. The red-fleshed pitaya's betacyanin and polyphenol content .pitayas with red flesh offer antioxidant properties and may help avoid chronic disease(3).Extensive experiments, such as those presented in this review, demonstrating the potential of plants of the Cactaceae family for suppressing the growth of different cancer cells and causing anticancer biological effects, further support this historical fact[4].

The dragon fruit is mainly crimson with huge bracteoles, oblong to oval, 6–12 cm long, and 4–9 cm thick. It features an inside of sweet flavored white or crimson pulp and a thin, leathery peel. The pulp contains tiny, edible seeds that are black in colour (Hylocereus undatus, n.d.). Typically, the fruit weighs between 150 and 600 g. The primary Hylocereus species that produce pitahaya are Hylocereus undatus, Hylocereus costaricensis, Hylocereus megalanthus, etc. Hylocereus produces tasty fruits with leathery skin [4]. Only a few phytochemicals, such as alkaloids, flavonoids, terpenes, and tannins, have been shown to have exceptional bioactivities against human diseases like cancer and diabetes [4].

Along with several other studies, dragon fruit also develops a number of therapeutic characteristics. Red dragon fruit's flesh functions well as an antioxidant. 18-20 In addition, it may have cardioprotective, anti-cancer, antimicrobial, anti-cholesterol, and anti-diabetic properties. The findings showed that betacyanin 2, flavonoid and phenolic 6,24, alkaloid, saponin, and tannin are abundant secondary metabolites in the flesh of red dragon fruit. Red dragon fruit is now only used on its flesh; the peels, which make up around 30–35% of the overall fruit mass, are not fully utilised. According to the phytochemical findings, the red dragon fruit peel includes certain secondary metabolites, including terpenoids and alkaloids. In addition, it contains triterpenes, phenol hydroquinone,

flavonoids, steroid, and saponin[5]. Besides. The fruit peel also offers number of benefits, including the fact that it is abundant, cheap, and a renewable resource. Additionally, betacyanins (a red pigment) and betaxanthin (a yellow pigment) are natural colourants found in the peel and pulp. The Cactaceae family of plants primarily inhabits deserts and semi-deserts, and they have evolved highly effective defence mechanisms that may thrive in extremely demanding environmental conditions (lack of water, strong radiation, temperature changes, poor soil). successfully adapt to one's surroundings. Alkaloids, flavonoids, terpenes, and tannins are among phytochemicals that make up this defence mechanism and have already demonstrated amazing biological activity[6]. Phytoconstituents that have been isolated have the potential to present virtually unexplored alternatives for the development of novel medications for the cosmetic and pharmaceutical industries. Due to potential negative effects from the usage of synthetic active ingredients, it is frequently highlighted that plant-based bioactive substances should be incorporated into existing formulations of skin care cosmetics. Pitaya, or dragon fruit, is well renowned for being very nourishing. This exotic fruit is used to make jam, wine, and ready-to-drink beverages[7][8].

DESCRIPTION OF FRUIT.

BOTANICAL CLASSIFICATION

▪ **Domain:** Eukaryote
▪ **Kingdom:** Plantae
▪ **Subkingdom:** Tracheobionta
▪ **Superdivision:** Spermatophyte
▪ **Division:** Magnoliophyta (Flowering plants)
▪ **Class**: Magnoliopsida (Dicotyledons)
▪ **Subclass:** Caryophyllidae
▪ **Order:** Caryophyllales
▪ **Family:** *Cactacea*e
▪ **Subfamily:** *Cereoideae*
▪ **Tribe:** *Hylocereae*
▪ **Genus:** *Hylocereus*

Table no1. Botanical Classification of Dragon Fruit[9].

VERNACULAR NAME

Chinese	huǒlóngguǒ (fire dragon fruit).
French	Cierge-lézard, Pithaya rouge, Pitaya.
Mexico	junco, Flor de calizs, 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, Pitajaya, Reina de la noche orejona.
Hindi	Dragon fruit.

Table no.2 Vernacular Name.

MORPHOLOGICAL SPECIFICATION

Pitaya comes in a number of varieties; each may be distinguished from the other by either the colour of the pulpy skin (exocarp) and/or the colour of the soft fleshy canter (mesocarp or endocarp), which contains the seeds[12].Pitaya fruit is best eaten when ripe, as it is not capricious in nature and loses quality during storage. At optimal maturity there are significant numbers of small black seeds with bright red/yellow skin and white/coloured flesh, depending on the variety. Dragon fruit has three main components: pulp (47.40 to 73.76%), peel (36.70 to 37.60%), and seeds (2.70 to 14.67%). The colour of the fruit pulp ranges from white shades of red and purple. Dragon fruits have red or yellow skin. Also, the red colour of the skin of the red dragon is more intense than the white colour. The seeds are small, soft in texture, edible, and black in colour. The most common varieties of dragon fruit are: This fruit has a very low ethylene production rate. Fruit shape ranges from nearly round to an oblong shape that is typical of the white-fleshed varieties from Fruit morphology such as size and colour of fruit is the main taxonomic evidences to differentiate among several Hylocereus spp. and also exhibits the external quality of fruit(10).Dragon fruit plant stems have the characteristics of scandent, climbing, widening, and branching. The stem is portly and watery, has a physical shape like a triangle. Dragon fruit stems have water and nutrient reserves like cactus plants in general so that these plants can survive even in extreme environments (low humidity and infertile soil)[(11)].

Peel	Red or yellow.
Flesh/Pulp	Red,Purple,White.
Seeds	Black.

Table No.3 Colour of different parts of fruit

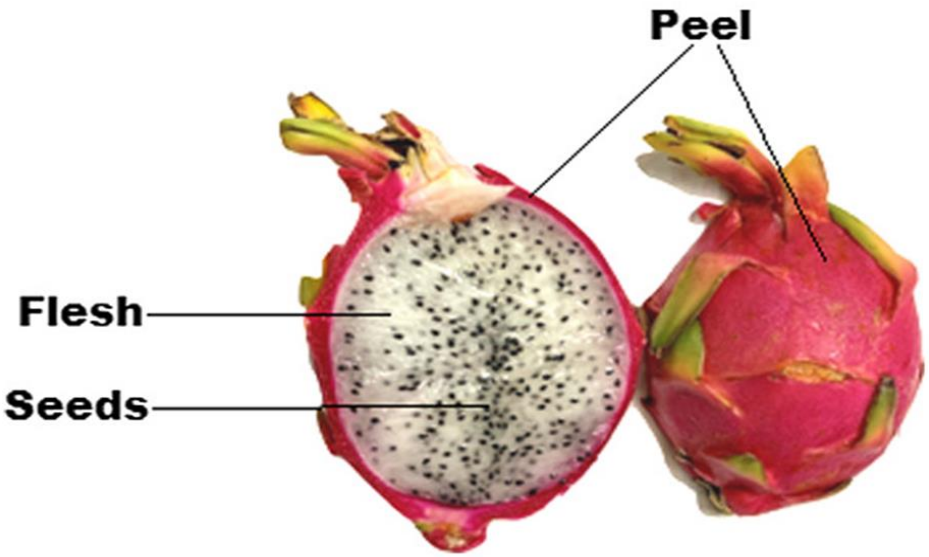

Fig No.1

TYPICAL FEATURE

i) climbing cacti, often epiphytic, with long stems often with three angles or 3-winged, freely branched, and branches emitting aerial roots, peduncles bearing short wool and some short spines, or rarely spineless;

ii) flowers are very large, funnel-shaped, usually open at night, with long, wide blades;

iii) ovary and carpel (pericarp) bearing bracts large but without spines, downy, woolly;

iv) Outer perianth segments similar to bracts on hypanthium, but longer;
inner petals narrow, pointed or spiny, mostly white, rarely red.

v) stamens are numerous, as long as the pattern, or shorter.

vi) spherical to oblong fruit, often red and fleshy, spineless but with few broad bracts, most of which are large and edible.

vii) small, black, oblong or kidney-shaped seeds (Britton and Rose 1920; Anderson 2001). Flower, stem and fruit morphology of *Hylocereus sp*.
The red pitaya *(Hylocereus polyrhizus*) and white pitaya (*Hylocereus undatus*) weights were 475 gm and 493 gm; while their lengths were 13.2 cm and 13.3 cm respectively. 302 gm and was 10.0 cm long. It was the smallest in size of the three pitaya. The major differences between the pitaya were the shape and peel colour. The red pitaya was round while the white and the yellow pitaya are oblong. The morphology of the three types of pitaya. Both red and white pitaya had red peel colour but red pitaya was a deeper red compared to the white[(12)].

The five species determined by Britton & Rose can be more precisely described by following types,

- ***H. purpusii***- It bears very large (25 cm) flowers with borders; the inner perianth segments are white, the middle perianth segments are golden, and the outer perianth segments are more or less reddish. It has a scarlet, rectangular fruit with huge scales covering it (length: 10-15 cm; weight: 150-400 g); red meat with

numerous little black seeds; and a good, if not overly noticeable, flesh Peel. *H. purpusii* and *H. ocamponis* (S.D.) are closely related; the only difference between the two is that *H. ocamponis* has acicular and slender spines.

- ***H. polyrhizus*** - Its long (25–30 cm) flowers have edges, outer perianth segments are reddish, especially at the terminals, and the stigma lobes are rather small and golden. The rectangular, scale-covered scarlet fruit (length: 0–12 cm; weight: 130–350 g) has a crimson flesh with numerous tiny black seeds, a lovely flesh texture, and a decent flavour. The main distinction between *H. venezuelensis* and *H. polyrhizus* is whether the stigma lobes are entire (*H. polyrhizus*) or bifid *(H. venezuelensis).*
- ***H. costaricensis*** - presents vigorous vines, perhaps the stoutest of this genus. Stems are waxy- white and flowers are nearly the same as H. polyrhizus; its scarlet fruit (diameter: 10– 15 cm; weight: 250–600 g) is ovoid and covered with scales that vary in size; it has a red- purple flesh with many small black seeds, pleasant flesh texture and good taste. A few varieties are known in Costa Rica: 'Lisa', 'Cebra' and 'Roja'.
- ***H. undatus*** -It has long, green stems that become more or less horny as its ages. Flowers can be up to 29 cm long, with green (or yellow-green) outer perianth segments and pure white inner segments. Its rosy-red fruit is oblong and coated in broad, long scales that are red and green at the tips. It has a white flesh that is filled with numerous small black seeds, a pleasing flesh texture, and a decent flavour.
- ***H. trigonus***- The fruits have thin, green stems with borders that are not horny. The crest of the undulation of the rib is where the areoles are situated. Initially greenish, the spines quickly turn dark brown. Its crimson fruit (7-9 cm in diameter and 120-250 g in weight) is ovoid or oblong and almost completely smooth [(13) (14).]

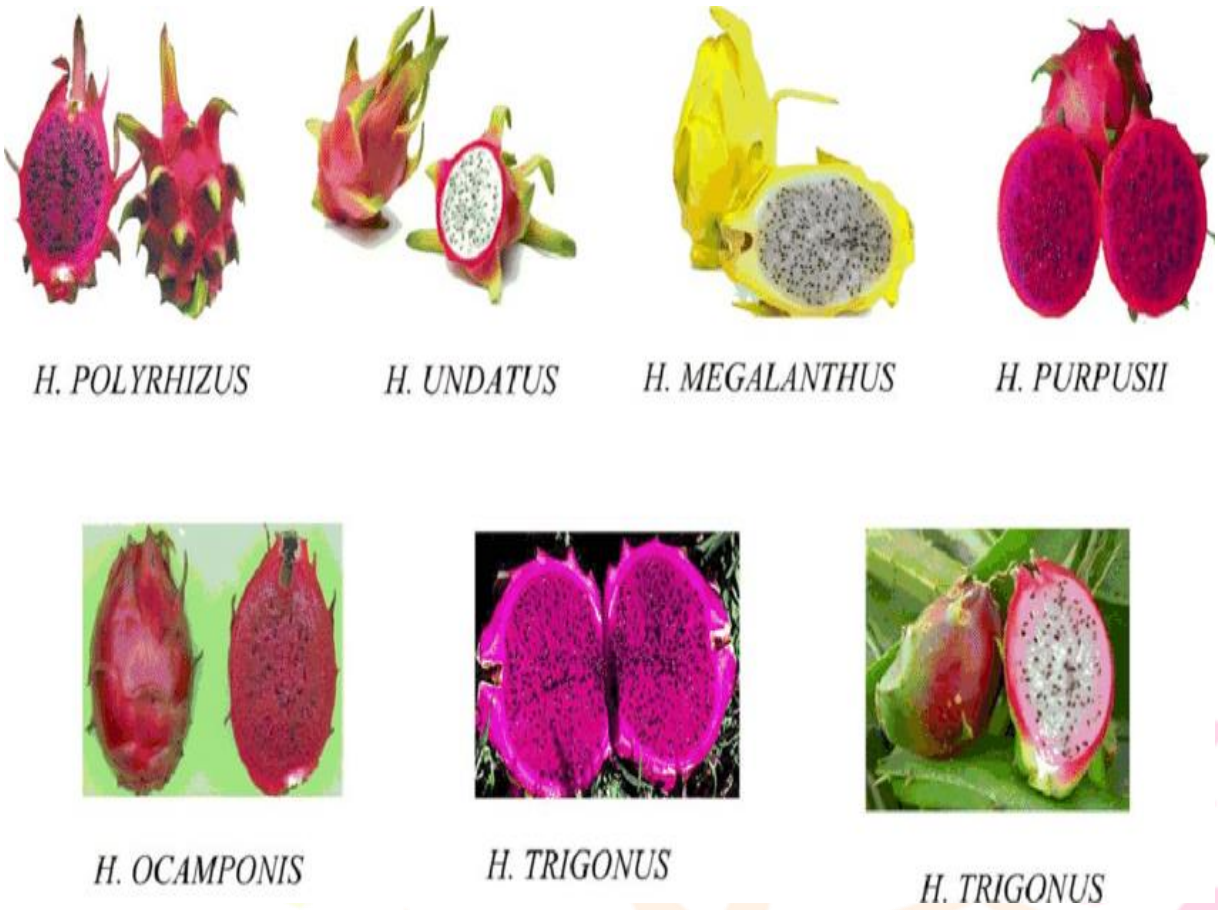

Fig.2 Different species of pitaya fruit

GEOGRAPHICAL ASPECTS

Pitayas are grown in tropical and subtropical regions. Vietnam has been growing and cultivating dragon fruit plants for more than a century, but over time, farmers in other countries, including Thailand, Australia, Israel, and the United States, have become interested in the practise as well. Many nations, including Australia, the United States, Israel, Vietnam, Nicaragua, and Taiwan have commercially grown dragon fruit plants. However, the majority of these plants that produce dragon fruit actually originate in Mexico, South, and Central America. This dragon fruit plant can grow well in Israel, namely in the Neveg Desert, and fruit production yields of 30% have been seen there[(11)]. On subtropical inland mountain slopes and along coastal plains in semiarid sections of Mexico's west coast, species that produce edible fruits are frequently encountered. Mexico's east coast and the Pimienta-barrios & nobel: pitaya in mexico (from Sonora to Oaxaca) route. The wild populations live in patches of 50 to 200 plants per hectare that are an essential component of the subtropical and tropical deciduous forests' natural ecosystems. Since ancient times, Indians have relied heavily on pitayas from wild Stenocereus thurberi in the arid and semi-arid regions of the Sonoran Desert, including Sonora and Sinaloa[(13)].

EXTRACTION OF PHYTOCONSTITUENTS

The fruit, flower, stem, and a variety of other parts of the Hylocereus plant can all be used to extract the plant's phytoconstituents. This assessment focuses on the plant's fruit. It is possible to extract phytoconstituents

from the fruit's meat, skin, and seeds. Pulp makes up two thirds of the fruit's weight, while seeds make up 8% of the total weight. The yield and molecular weight of oligosaccharides extracted from dragon fruit were shown to be reliant on the extraction strategy, more specifically the extraction solvent, according to a number of reported extraction procedures for phytoconstituents from dragon fruit and related records. It is possible to purify oligosaccharides utilising traditional chromatographic and membrane filtering techniques as well as cutting-edge biological methods. to improve extraction by reducing moisture content, the stored (80°C freezer) sections of fruit flesh and peel were spray-dried. By limiting the fruit's exposure to mild, pigment loss is less likely to occur. The choice of extraction method depends on the fruit part being utilised for extraction, according to a comparison of conventional technique and ultrasonic-assisted extraction method. Flesh extraction yield and peel flavonoid content material both enhanced. the application of ultrasonic extraction. The extraction of particular phytoconstituents can be aided by the use of selective reagents and circumstances. have employed three different extraction methods, including ammonium oxalate (0.25%), pH 4.6 0.01 at 85 °C for one hour, and hydrochloric acid (0.03 M; pH 1.49 0.02) at 85 °C for one hour with the use of ammonium oxalate, the yield and purity of pectin obtained from dragon fruit have been most [(15)].

PHYTOCHEMICAL CONSTITUENTS OF PITAYA FRUIT.

The potential nutrients and bioactive phytochemicals in pitaya fruit have been widely studied. In particular, pitaya is the only commercial edible fruit that contains high levels of betalains, which are water-soluble, tyrosine- originated alkaloid pigments restricted to the species of order Caryophyllales. Their perspective beneficial properties in human health and nutrition are well documented, driven partly by their antioxidant effects. Therefore, betalains in pitaya fruit are not only beneficial to human health but can also help consumers distinguish cultivars. In addition, betalains are considered a good resource for the food industry, as they are extensively utilized as economically important natural colorants of food and as functional foods[20].Phytochemicals are described as the bioactive, non-nutrient plant compounds. those compounds are secondary plant metabolites, and they may be associated with health advantages. In current years, there has been increasing interest not simplest within the identification of the phytochemical compounds present in dragon fruit but also in the exploitation in their potential medicinal properties. Betalains, flavonoids, polyphenols, terpenoids, steroids, saponins, alkaloids, tannins, and carotenoids are bioactive compounds which can be extracted from all the parts of the pitaya. therefore, no longer most effective the edible elements of the dragon fruit, i.e. the pulp, but also the waste parts like the peels are wealthy in phytochemicals and hence have capacity uses as natural medicinal drug or herbal colourants.

Polyphenols are a group of antioxidant compounds derived from plants, including phenolic acids, flavonoids, stilbenes and lignin, with high radical scavenging ability that reduces the risk of chronic diseases (cancers and cardiovascular problems)[(14)]. Polyphenols are reported to actively stimulate the growth of health-boosting microbes, including Lactobacillus, Barnesville and Bifidobacterium, in the human gut while impeding the growth of unhealthy microbes, e.g., Escherichia coli. Polyphenols were found to inhibit α-amylase and α-

glucosidase activity together with the modulation of postprandial hyper-glycaemia due to the interaction between starch and polyphenols[15]. Pitaya seeds and peels possesse higher total polyphenols and betacyanins compared to pulps. Betalains are a group of natural water-soluble nitrogen-containing pigments that originated from tyrosine in fruits and vegetables and are divided into two groups: betacyanins and betaxanthins[16]. Polysaccharides are a group of long-chain polymeric carbohydrates composed of more than hundred monosaccharides bound with glycosidic linkages[17]. Polysaccharides present in pitaya peel have attracted much attention in recent years for use in food products as thickeners, stabilisers and gelling agents. Red pitaya peel is one of the most important sources of pectin, a high-molecular-weight natural polysaccharide, accounting for up to 35% of cell walls. Pectin is a group of galacturonic acid-rich polysaccharides and can be divided into two major groups, namely high methoxy and low methoxy pectin (higher and lower than 50% degree of esterification, respectively). There are nine essential amino acids, namely histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine, that cannot be synthesized in the human body and must be obtained from foods[12]. Triterpenoids are another group of phytochemicals that are found in fruits and vegetables and exhibit antioxidant and anti-cancer effects. Based on anticancer efficacy present in animal models.

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 30. 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. 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 contain 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 hydrolyzable tannins like gallotannins 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, quercetinan, and kaempferol 29. 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, tetradecanesulfonic acid, butyl ester, tetratriacontane, heptacosane, n-hexadecanoic acid, 1,2-benzenedicarboxylic acid, mono (2 ethylhexyl) ester, (Z,Z)-9, 12-octadec acid,17-pentatriacontene, eicosane, y-sitosterol[18].

Protein, fat, carbohydrate, crude fibre, flavonoid, thiamin, niacin, pyridoxine, kobalamin, glucose, phenolic, betacyanins, polyphenol, carotene, phosphorus, iron, and phytoalbumin12 are all abundant in the plant Hylocereus undatus. It has a high concentration of phytoalbumins, which are highly prized for their antioxidant effect[1].

Parts of pitaya	Phytochemistry of aerial parts of fruit.	Varieties
Fruit	Glycosides, alkaloids, saponins, phenolic compounds, tannins, flavonoids, proteins, steroids, alkaloids.	*H. undantus.*
Pulp	Betanin, phyllocactin, and hylocerenin are the three main components found in fruit, and there are seven betacyanin compounds in the pulp and ten in the peel. H. ocamponis peel Pigments Betacyanin profiles 1 through 10 were found in the fruit peel of H. ocamponis, including betanidin 5-O-sophoroside, betanin, 2'-Apiosyl-betanin, phyllocactin, 4'-Malonyl-betanin, hylocerenin, 2'-Apiosyl-phyllocactin, 5''-O-E-Ferul steroids, phenol, flavonoids, betacynin, terpenoids, and batalain(19).	*H. polyrhizus.* *H. undantus.*
Seeds	Myristic, Palmitic, Stearic, Arachidic, Palmitoleic, Oleic, Erucic, Linoleic, Linolenic, Saturated fatty acid, Monounsaturated fatty acid, Polyunsaturated fatty acid.	*H. undantus.* *H. polyrhizus.*
Peels	There are 13 phenolic compounds: apigenin, jasmonic acid, oxooctadecanoic acid, 2,3,4-dihydroxyphenyl-7, hydroxy-5-benzene propanoic acid, and protocatechuic acid. Quinic acid, cinnamic acid, quinic acid isomer, 3,4, -dihydroxyvinyl (15). benzene, isorhamnetin 3-O-rutinoside, myricetin Acid citral.	*H. Polyrhizus.*

TRADITIONAL ASPECTS

In Central America, where pitayas are frequently produced in household gardens, pitaya has long been used as a traditional medicine and food. The pitaya plant's leaves and blossoms were utilised as a diuretic and curative by the prehistoric Mayas. Pitaya fruits are also used by Mayas as a diuretic, hypoglycemic, anti-heart disease, wound disinfectant, tumour dissolving agent, and a treatment for dysentery[20]. Additionally, the fruit has been demonstrated to have an impact on gastritis, the fruit can be used to treat renal issues, the flowers can be drunk raw or made into a tea, the seeds have a laxative effect, and the stalk can be used to treat kidney issues 3

NUTRITITIVE ASPECTS

Drugs can mask symptoms and herbs can stimulate body function that have gone awry, but health will elude the patient so long as there is an underlying lack of essential nutrients in the body. Health problems increasingly being trace to nutritional deficiencies that can be connected by supplying the missing vitamins, minerals, amino acids, and so on. Dragon fruit includes the numerous numbers of nutritive value. The fruit is a desirable raw ingredient for many different sorts of drinks, including fermented drinks or beverages made with enzymes because of its nutritional value and pulp colour[21]. In addition to being used as a food colouring agent, consumption of Dragon fruit mostly as fresh fruit as relieving thirst due to it contains high water level compared with other nutrient levels. Health benefits of Dragon fruit is also rich in flavonoids that act against cardio related problems, also dragon fruit aids to treat bleeding problems of vaginal discharge[22]. Dragon fruits are rich in fibers; however, it aids in digestion of food. Dragon fruit is also packed with B vitamin group (B1, B2 and B3) which possess an important role in health benefit. Vitamin B1 helps in increasing energy production and in carbohydrate metabolism, Vitamin B2 in Dragon Fruit acts as a multivitamin; however, it aids to improve and recover the loss of appetite. And Vitamin B3 present in dragon fruit plays an important role in lowering bad cholesterol levels; it provides smooth and moisturizes skin appearance. As well as it improves eye sight and prevent hypertension. Dragon fruit is also helpful in reducing blood sugar levels in people suffering from type 2 diabetes, studies suggest that the glucose found in Dragon fruit helps in controlling the blood sugar level for diabetes patients. It contains high level of phosphorus and calcium. It helps to reinforce bones and play an important role in tissue formation and forms healthy teeth[9].

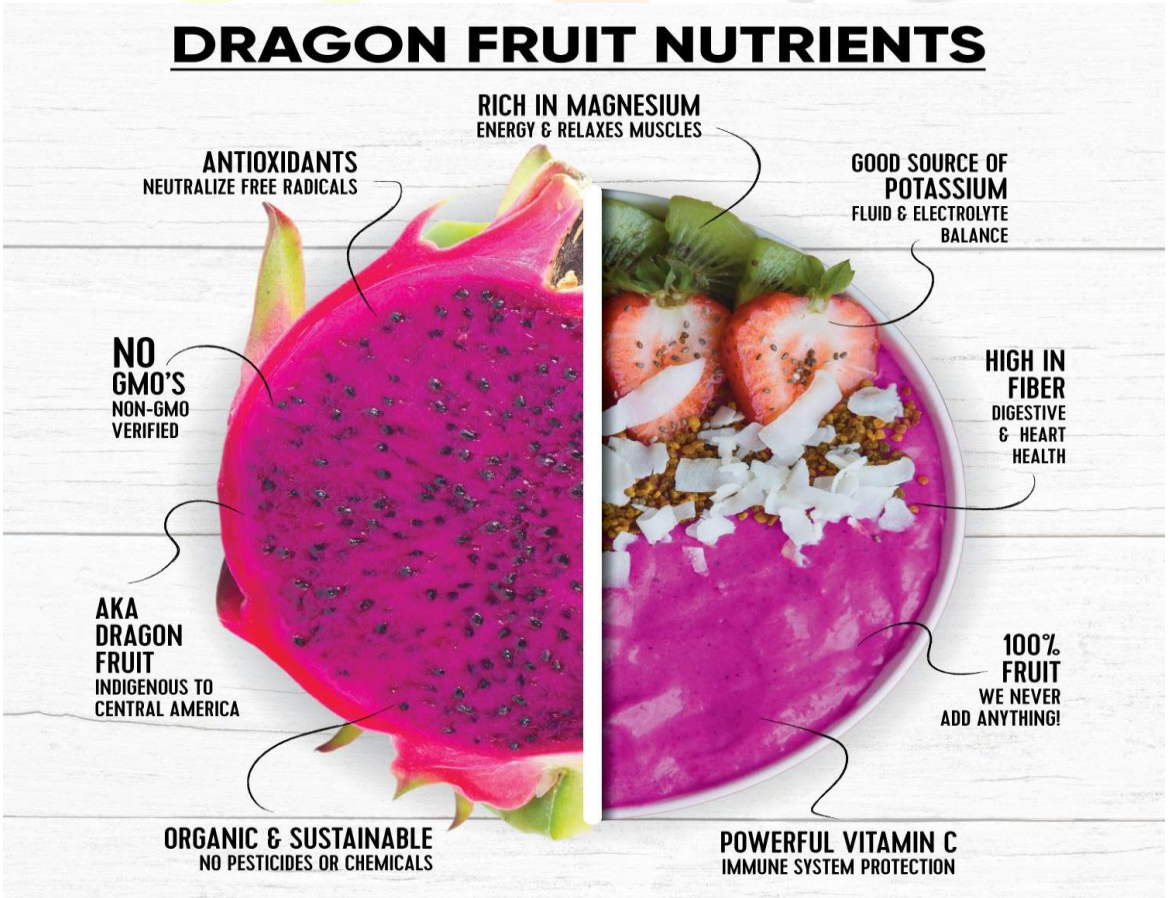

Fig no.2 Dragon fruit nutrients

• Dragon fruit promotes healing of wounds and cuts.

• Dragon fruit progresses appetite.

• Dragon fruit recovers eye sight.

• Dragon fruit can help in weight reduction.

• Dragon fruit expands memory.

• Dragon fruit can be used as an aspect in useful meals and nutraceutical merchandise for the overweight people and diabetic prevention control. meanwhile, the prebiotic effect of dragon fruit have to be tested in clinical research with both the raw and extracted flesh for contrast[23].

MEDICINAL EFFICIENCY

Today we know that the consumption of fruits and vegetables can serve to reduce the can be a strategy to reduce the incidence of diseases because the content of phytochemicals that have a positive impact on health is high. Especially the content of nutrients such as vitamin B2, vitamin B3, vitamin B1, vitamin C, fats, carbohydrates, proteins, betacyanins, polyphenols, iron, Phyto albumin, carotene, cobalamin, glucose and phenols. Pitahaya has positive effects on the digestive process, as an anti-diabetic, lowers blood pressure, neutralizes toxins in the body, especially heavy metal toxins, helps treat asthma as well as cough and prevents various types of cancer especially colon cancer. Dragon fruit contains Phyto albumin which has a protective effect against cancer and the iron content is also found in red dragon fruit is able to increase the levels of erythrocytes and haemoglobin so it can be used as a treatment for anaemia. In addition to the presence of polyphenols and flavonoids, there are also other phytochemicals in Pitahaya called betacyanins and betaxanthins that are part of the betalains. Studies show that betacyanins in dragon fruit have an action against free radicals. As is well known, free radicals damage the body. As they are capable of causing neurodegenerative diseases, aging or heart problems. The white dragon fruit (*Hyolecerus undatus*) in the medical field plays a role in the wound healing process especially the leaves and water extract of the flowers which were mixed in topical preparation[21].

PHARMACOLOGICAL ACTIVITIES

ANTIBIABETIC ACTIVITY

Diabetes mellitus is a metabolic and/or hormonal disorder that is typically characterised by persistent hyperglycemia as a result of deficiencies in pancreatic B-cell production of insulin and/or decreased sensitivity of cell surface receptors to insulin. One of the medicinal plants, dragon fruit, has been suggested as a potential treatment for diabetes mellitus. The regeneration of pancreatic cells and the attenuation of fibroblast growth factor-21 (FGF-21) resistance are two mechanisms by which dragon fruit has been shown to have anti-diabetic effects in animal investigations[24]. The usefulness of dragon fruit in people with prediabetes has been studied in numerous non-randomized and randomised controlled trials. Many plants and fruits, like dragon fruit, have the potential to be anti-diabetic. Numerous studies have demonstrated that red dragon fruit can lower blood sugar levels in people with Type II Diabetes, serving as an antidiabetic agent. Glucose, a component in red dragon fruit,

reduces blood sugar levels. In addition to reducing blood glucose levels, the dietary fibre in dragon fruit tends to minimize very rapidly food is degraded in the intestines. The use of dried dragon fruit also has specific results as an herb for antidiabetic activity. The utilization of dried dragon fruit as a herb for antidiabetic intervention also yields desired outcomes. Additionally to controlling blood sugar, the dietary fibre in dragon fruit assists to minimize how quickly food is degraded in the intestines[(25)]. The use of dragon fruit is not limited to the flesh of the fruit for its therapies based. Both the seeds and peel of dragon fruit are anti-diabetic. In particular for individuals with type II diabetes, dragon fruit seeds contain saponins that are useful as an anti-diabetic agent and are soluble in water extracts. The peel of dragon fruit is assumed to contain soluble fibres that can modulate the body's blood sugar levels[(26)].

In general, diabetics develop wounds that are challenging to heal. However, it was discovered in one study that using Hyolecerus undatus, sometimes known as white dragon fruit, has the effect of quickening the healing process. Topical treatments made from flower or leaf water extracts are the most efficient white dragon fruit remedies for diabetics' wound healing. Due to its high DNA collagen concentration, elevated epithelialization, hydroxypoline, tensile strength, and total protein content, white dragon fruit is used in the wound healing process in diabetics. Three separate control groups and three treatment arms were compared. Each comparison was handled as a distinct research in this situation. The combined data revealed a substantial decrease in FPG favouring dragon fruit, with(5) with a mean difference (MD) of -15.1 mg/dL (95% CI: -23.8 to -6.5 mg/dL, P-value = 0.0006) Three studies [13, 14, 21] provided data for the meta-analysis (Heterogeneity: Chi2 = 0.2, df = 2; I2 = 0%, 95% CI: 0-62%). Separate analyses were done for 2HPP and FPG. In two investigations, two treatment arms were compared with a central controlling group[(5)].

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 50 µ(27). The agar well (6 mm Ø) diffusion method was used for the determination of antimicrobial activities. For each test, 100 µL of the sample was added to the well. After incubation at 37 °C (bacteria)/27 °C (Candida albicans) for 24 horat22 °C for 4–12 days (Aspergillus Niger), the resulting inhibition zone diameters were measured. Furthermore, the minimum inhibitory and bactericide concentrations (MIC and MBC, respectively) of the phenolic extracts against the test microorganisms were determined using the broth microdilution method followed by the counting of surviving cells on PCA plates[16]. All tests were performed in

triplicate. A range of microorganisms were tested: Staphylococcus aureus (ATCC 6538 and ATCC 25923), Staphylococcus epidermidis (CIP 106510) and Bacillus cereus ATCC 11778 for Gram-positive bacteria; Escherichia coli (ATCC 8739 and ATCC 35218), Pseudomonas aeruginosa (ATCC 9027 and ATCC 27853), and a Salmonella sp. strain (isolated from food) for Gram-negative bacteria; the yeast Candida albicans (ATCC 14053); and the mold Aspergillus Niger[28].

ANTI-INFLAMMATORY ACTIVITY

Anti-inflammatory action has been performed on dragon fruit. Utilising EPR and HPLC a cell-based investigation looked into the anti-inflammatory capabilities. Two forms of paramagnetic species in dragon fruits that had anti-inflammatory study. We talked about the EPR line widths and phytochemical functions of different dragon fruit components[29]. Dragon fruit peel and flesh were combined for the investigation, then separated using vacuum distilled water, water, and drying. Following that, the outcomes of this will be used to conduct bioassay testing against Cyclooxygenase-2 (COX-2), Acetylcholinesterase Enzymes (AChE), and 5-Lipoxygenase (5-Lipox). These research' findings indicate that extracts from dragon fruit flesh demonstrated outstanding results in the bioassay test against the three enzymes and shown a larger inhibitory power on the Acetylcholinesterase enzyme than on the other enzymes. As can be observed from the mechanism that is directly connected to cholinergic anti-inflammatory, this has demonstrated that dragon fruit has the capacity to relieve inflammatory symptoms. Additionally, the effects of dragon fruit flesh on Lipox and COX. The leukotriene and prostaglandin pathways can become blocked by enzymes because of their great potency, according to 46. This demonstrates that the anti-inflammatory effects of dragon fruit exist. The betalain found in red dragon fruit peel extract has the capacity to suppress the transcription factor NF-B, preventing the separation of inflammatory genes like TNF- and IL-1.[17].

ANTIFUNGAL ACTIVITY

A dragon fruit Numerous studies have been done on the possible use of plant and fruit extracts as antibacterial agents as a result of the discovery that natural sources like plants and fruits are antibacterial. Similarly, it was discovered that plant by products had the capacity to eradicate germs [19]. Extracts and fractions of the flesh and peel of red pitaya fruits have polyphenol antifungal activity against two yeasts, Candida albicans and Rhizoctonia solani, as well as four moulds: Aspergillus flavus, Fusarium oxysporum, Botrytis cinerea, and Cladosporium herbarum. which is the research team that makes use of strains from the American Type Culture Collection used as laboratory controls. Yeasts, Candida albicans, Rhizoctonia solani, and four molds Aspergillus flavus, Fusarium oxysporum, Botrytis cinerea, and Cladosporium herbarum as well as yeasts, Candida albicans, and Rhizoctonia solani are present in extracts and fractions of the flesh and peels of red pitaya fruits, which are known to contain polyphenol antifungal activity[28].

ANTIOXIDANT ACTIVITY

Many of the fruits are rich in vitamins, antioxidants, and have a variety of health benefits. Antioxidants are molecules that may shield your cells from free radicals, which have been linked to cancer, heart disease, and

other illnesses. Free radicals are molecules that are created when food is broken down by the body, when you are exposed to radiation or tobacco smoke, or both. The antioxidant activity of the dragon fruit is performed with the use of several extracts.

DPPH radical-scavenging assay

The DPPH radical-scavenging activity was measured using a previously described method A 30-µL aliquot of each sample diluted in PBS (or PBS without test sample as a control) was added to 30 µl of DPPH (60 µm) in ethanol. The final concentration of each pitaya extract was 25µg/ml. After mixing vigorously for 10 s, solutions were transferred to 50-µL Teflon capillary tubes and inserted into the cavity of a JES-FA200 ESR spectrometer (JEOL, Tokyo, Japan). Supernatants were measured 2 min subsequently. Measurement conditions were as follows: central field 3475 G, modulation frequency 100 kHz, modulation amplitude 2 G, microwave power 5 mw, gain 6.3 × 105, and temperature 297 K. The radical-scavenging activities of the pitaya extracts were calculated according to the following hx are the ESR signal intensities of samples containing and not formula: Scavenging rate = (h0 − hx)/h0 × 100%, where h0 and containing extract, respectively[30][31].

Free radical-scavenging activity

The measured antioxidant activity of a biological material usually varies by method as many chemical analyses measure the ability of a test material to inhibit the oxidation of a target substrate by a specific free radical, for example, superoxide anion or hydroxyl or peroxy radicals. Since electron spin resonance (ESR) provides a sensitive, direct, and accurate means of monitoring reactive species, we used it to compare the DPPH, hydroxyl, and alkyl radical-scavenging abilities of the 80% methanol extracts of red and white pitaya flesh and peel (using catechin as a standard)[31][27][32].

ANTIULCER ACTIVITY

The topical quercetin content within the pores and skin of purple dragon fruit (Hylocereus polyrhizus) indicates antiulcer interest. it may be proven from the effects of general distress in 35% of instances within 2 to 4 days and in 90% of instances inside four to 7 days(18).Quercetin is beneficial for lowering the frequency of relapses and relieving moderate symptom[33].

ANTIPLATELET ACTIVITY

Dragon fruit has antiplatelet pastime as it includes ethanol and ethyl acetate extracts which have inhibitory consequences in concentration-established way on platelet aggregations precipitated by using various agonist[11].

HEPATOPROTECTIVE ACTIVITY.

On rats that have been poisoned, dragon fruit extracts do work favourably. due to the high levels of antioxidants it contains, which come from the CCl4 intake already mentioned. Triterpenes and flavonoids, in particular, are phytochemical components that protect the liver from lipid peroxidation. However, the silymarin pill has little protective effect against liver damage due to a subsequent I Improvement in serum glutamic-pyruvic transaminase (SGPT) and serum glutamic-oxaloacetic transaminase (SGOT). It has been demonstrated that

dragon fruit extracts are effective in preventing rats from suffering chronic liver damage when exposed to CCl4(34). the experimental animals received oral administration of the dragon fruit extracts for seven days at a dose of 2500mg/kg body weight. Using an Erlenmeyer flask and stirring rod, the extracts were dissolved in distilled water at a ratio of 105 gm. extract to 520 ml water. The extracts were given directly to the gastrointestinal tract of the experimental animals using a three (3) ml sterile syringe and a gavage needle to prevent spillage. Blood was drawn from the tails of the experimental rats after the induction of CCl4 for a preliminary assessment of liver function. After seven days of treatment, the albino wistar rats were taken out of the experiment and denied food. Following the administration of the Hylocereus polyrhizus extracts for twenty-four hours [(23)].

Blood was also collected from the tail. The drawn blood samples were vertically positioned on the poly tray in sterile glass top tubes. Electrochemiluminiscence immunoassay was utilised to assess liver function. Serum glutamic axaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT) were examined as blood biochemical components. The blood samples utilised for the analysis of the biochemical signs of liver injury were centrifuged at 3400 rpm for 10 minutes to separate the serum. The Best Diagnostic Corporation ISO (9001:2008) in Rodamel Building, Carig Sur, Tuguegarao City, Cagayan34 performed the analysis of blood biochemical composition[(34)].

ANTICANCER ACTIVITY

One of the biggest causes of death in the world is cancer, which requires care. (Book cite) Natural substances' anticancer properties can be very helpful in the treatment of cancer. The cytotoxic nature of dragon fruit phytoconstituents has been demonstrated in numerous research. the MTT assay to determine the cytotoxic potential of dragon fruit peel extract(20). The extracts demonstrated a dose-dependent cytotoxic activity against the human gastric cancer cell line MGC-803, the human breast cancer cell line Bcap-37, and the human prostate cancer cell line PC3. The range of the IC50 value was 0.61 to 0.73 mg/ml. On MGC-803 cells, H. polyrhizus demonstrated a more potent cytotoxic impact than H. undatus. Individual phytoconstituents, including -amyrin, -amyrin, -sitosterol, and stigmast-4-en-3-one, were also tested for their cytotoxic effects on these three cell lines. Other tested phytoconstituents showed strong cytotoxic action against cell lines, suggesting that -amyrin, -sitosterol, and stigmast-4-en-3-one may have anticancer potential. Using the MTT assay, research by revealed that a methanolic extract of dragon fruit was efficient against multiplying MCF-7 cells. Because nitric oxide radical is known to be connected to the aetiology of cancer, the extract's ability to scavenge nitric oxide can be linked to its anticancer effect[(6)]. The use of nanoparticles in the treatment of cancer offers various benefits. In order to create luminous nitrogen-doped carbon dots (N-CDs), aqueous ammonia and H. undatus extract were utilised as the sources of carbon and nitrogen, respectively. The synthetic N-CDs had a 2.5 nm average size and a spherical shape. Following the characterisation, N-CDs on the L-929 (Lymphoblastoid-929) and MCF-7 (Michigan Cancer Foundation-7) cell lines were examined using the MTT assay. N-CDs demonstrated a stronger cytotoxic effect on MCF-7 cells and a minor effect on L-929 cells, demonstrating their target specificity. When compared to the antiproliferative effect of dragon fruit peel and flesh on B16F10 melanoma cells, the selective action of MCF-7 cells may be caused by the potential participation of the receptor-mediated endocytosis pathway.

The study found that fruit peel has superior antiproliferative activity over fruit flesh. the relationship between the amount of total flavonoids and total polyphenols in the flesh and peel of white and red pitayas and their capacity to inhibit cell proliferation. In comparison to the fruit meat, the flavonoid and polyphenol content of dragon fruit peels was 3 to 5 times higher. Similar to this, fruit peel extract showed more antiproliferative activity than flesh extracts against AGS and MCF-7 cancer cells. the relationship between the amount of total flavonoids and total polyphenols in the flesh and peel of white and red pitayas and their capacity to inhibit cell proliferation. In comparison to the fruit meat, the flavonoid and polyphenol content of dragon fruit peels was 3 to 5 times higher. Similar to this, fruit peel extract showed more antiproliferative activity than flesh extracts against AGS and MCF-7 cancer cells. Dragon fruit's phenolic content and antioxidant effects were positively correlated, however no link could be found between antioxidant and antiproliferative activity. Green synthesis, which eliminates the use of potentially harmful chemicals and concentrates on the utilisation of natural ingredients, is a great environmentally responsible way for creating nanoparticles. It has created green synthesis-produced dragon fruit extract-capped gold nanoparticles. In the creation of gold nanoparticles, the dragon fruit extract demonstrated a dual function as a capping and reducing agent. The resulting nanoparticles were 10–20 nm in size. The created nanoparticles demonstrated selective cytoxically active.

dragon fruit extract can be efficiently used in cancer therapy especially breast cancer therapy [32].

ANTIVIRAL ACTIVITY

Virus-borne dengue fever is an infectious illness (DENV). DENV is a virus carried by arthropods that is mostly spread to people by female Aedes aegypti mosquitoes in tropical and subtropical areas of the world. There is currently no antiviral treatment for dengue illness, and the only licenced dengue vaccine, Dengvaxia, had variable efficiency across individuals. In order to control dengue infection and stop patients from progressing from dengue fever to DHF or DSS, antiviral medication must be developed. Combining the vaccine with natural antiviral medicines can help suppress DENV infection. There is a study gap regarding betacyanin's antiviral action against human pathogenic viruses because it has only been reported to work against tobacco mosaic virus in plants. Red pitahaya (Hylocereus polyrhizus) and red spinach (Amaranthus dubius) are two fruitful plants that are frequently grown in tropical and subtropical nations where dengue fever is endemic. By using a test, such as the host cell cytotoxicity assay, virus yield inhibition assay, or virucidal assay, antiviral activity can be demonstrated. One day before the experiment, 1 104 cells ml-1 of vero cells (African green monkey kidney; ATCC CCL-18) were planted on 96-well plates. Growth medium [1minimum essential medium (MEM) containing 2% foetal bovine serum (FBS), 1% HEPES, and 1% penicillin- streptomycin antibiotic] containing varying concentrations of betacyanin fractions from red pitahaya and red spinach was applied to the confluent cells for 48 hours at 37°C in a humid incubator with 5% CO2. After a single PBS wash, the cells were treated with 10 l of a 5-mg/ml solution of 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) reagent and incubated for 4 hours at 37 °C with 5% CO2. The solubilization solution (10% SDS in 0.01 N HCl) was then added in 100 l, and the plate was then incubated for an additional overnight. A microplate reader (Bio- Rad, Hercules, USA) was used to

measure the absorbance at 560 nm. (OD560). From the dose-response curve, the half maximum cytotoxicity concentration (CC50) and cell viability (%) were computed[35].

ANTIHYPERLIPIDEMIC AND ANTI OBESITY ACTIVITY

As it is known to encourage atherosclerosis, dyslipidaemia is a complicated condition that poses a significant risk for unfavourable cardiovascular outcomes. In order to assess the impact of red dragon fruit peel powder (H. polyrhizus) on blood lipid levels, several groups of hyperlipidaemic Balb-C male mice were given varying doses of pitaya peel powder over the course of 30 days, ranging from 50 to 200 mg kg-1 BW.(Blood samples from each group were tested for total cholesterol, triglycerides, and low-density lipoprotein cholesterol (LDL-c) after the therapy, and the results revealed that all these parameters dropped when the red dragon fruit peel powder dosage was increased. pointed out that the advantages of pitaya peel powder's composition would make it possible for it to prevent hyperlipidemia when added to foods: Because it traps cholesterol and bile acids in the small intestine, increases insulin sensitivity, and increases satiety, the peel's high content of crude fibre (69.30% total dietary fibre, divided into 56.50% insoluble food fibre and 14.82% soluble food fibre) helps people consume fewer calories. The peel also contains a lot of antioxidants like phenol and tocotrienol. Vitamin E lowers plasma total cholesterol and LDL cholesterol concentrations as well as hepatic cholesterol levels. According to a study on the anti-obesity and hypolipidemic activity of *H. costaricensis* methanol flesh extract, obese rats fed the extract at a dose of 100 mg kg-1 BW experienced significant reductions in body weight, the Lee obesity index, organ weight, visceral fat weight, total cholesterol, low-density lipoprotein, triglycerides, very low-density lipoprotein, and the ratio of total cholesterol to high-density These rats, however, had higher levels of HDL cholesterol, faecal fat, and cholesterol. In vitro testing of white pitaya (H. undatus) juice extract for its anti-inflammatory, anti-diabetic, and anti-lipase properties. The white dragon fruit's phytochemical screening identified the existence of bioactive substances with antioxidant, anti-diabetic, and anti-lipase properties, including triterpenoid, alkaloid, flavonoid, and saponin, all of which have significant value and prospective applications. Simply said, the bioactive components in dragon fruit extracts, such as the crude fibre, phenolic, polyphenol, and flavonoid content, help lower the serum lipid profile by preventing cholesterol from being absorbed in the intestine and promoting its elimination through the faeces[36].

PREBIOTIC ACTIVITY

In the ethanolic extract of H. undatus meat, mixed oligosaccharides made up around 85% of the sample. Compared to inulin, these oligosaccharides were more resistant to the salivary -amylase. These operate as prebiotics, which promote the growth of the good bacteria lactobacilli and bifidobacteria, and are not digested in the stomach. These microbes will aid in digestion and maintain a robust immune system[37].

ANTI COLLAGEN ACTIVITY

Red pitaya peels with the greatest concentration of 1000 g/ml had an excellent collagenase inhibition percentage of 96.920.02%, whereas the standard solution of ascorbic acid exhibited 97.970.18%, according to an anti-collagenase activity assay that was conducted using ascorbic acid as a standard. While ascorbic acid was very

active against collagenase with an IC50 of 7.670.11 g/ml, the red pitaya peel extract only demonstrated moderate collagenase inhibitory activity with a value of (16.280.14) g/ml. The findings suggested that red pitaya peel extract has the same capacity as ascorbic acid for inhibiting collagenase enzymes, indicating its potential as an effective anti-aging agent[38].

ANTI-ELASTASE ACTIVITY

The capacity of red pitaya peel extract to inhibit the elastase enzyme was used to gauge its potential for helping with skin anti-aging qualities. Red pitaya peels had a high elastase inhibition percentage of 87.620.05%, compared to the standard solution of ascorbic acid, in the anti-elastase activity assay, which was carried out using ascorbic acid as a standard. Four categories were used to group the anti-elastase activity results: very active, moderately active, weakly active, and inactive. Ascorbic acid demonstrated strong anti-elastase action, whereas the red pitaya peel extract exhibited only moderate anti-elastase activity. Considering that ascorbic acid is a single molecule as opposed to the red pitaya peel, it is obvious that it was the stronger inhibitor of the elastase enzyme [24].

ANDROGENIC AVTIVITY

The highly ordered and intricate processes of spermatogenesis and steroidogenesis are performed by the testes. While steroidogenesis is the full series of enzymatic events that result in the creation of androgens, the male sexual hormones, spermatogenesis encompasses all processes involved in the development of gametes. The components of dragon fruit, ß-sitosterol and ß-ß- amyrin acetate, are thought to have beneficial effects on male mammals' reproductive function[39].The results demonstrated that pitaya fruit extract at a dose of 500 mg/kg significantly increased sperm count, while extract at a dose of 1000 mg/kg significantly boosted sperm production and viability. However, due to a paucity of research, it is still unknown how the dragon fruit's peel and pulp affect the androgenic condition of animals[40].

CONCLUSION

According to its natural bioactive properties, including its ability to manage and reduce oxidative stress, the dragon fruit has a variety of therapeutic benefits for individuals. The pitaya has bioactive chemicals in all of its many parts, including the stems, flowers, peels, pulp, and other parts. These substances have a variety of beneficial biological effects, including antioxidant, antibacterial, and anticancer properties. It has been demonstrated that these natural substances are more effective than synthetic drugs in the treatment and prevention of a variety of diseases, including diabetes, cancer, obesity, hyperlipidemia, and pathogenic organisms like viruses, bacteria, and fungi. They are also more sustainable, safer, and healthier. Along with the medicinal value of its constituents, the pitaya may be effective as a prebiotic. Additionally, it provides natural colourants. Dragon fruits typically feature a variety of commercially enticing qualities that bring producers from all over India due to its exceptional nutritional content and appealing shape and colour. The minerals and phytochemicals in dragon fruit are beneficial to the body. This research still has to be examined and verified in order to be more convincing that dragon fruit may be utilised for alternative sickness prevention and treatment.

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