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EXPLORING DRAGON FRUIT: A COMPREHENSIVE REVIEW

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ABSTRACT

Dragon fruit, known scientifically as Hylocereus polyrhizus and Hylocereus undatus, belongs to the Cactaceae family. This fruit is rich in antioxidants such as betalains, hydroxyl cinnamates, and flavonoids, which protect cells from free radicals, thereby reducing the risk of aging and chronic diseases. Dragon fruit is also abundant in vitamin C and phytoalbumins, known for their antioxidant properties that promote skin tightening and softening, resulting in a radiant complexion. Regular use of dragon fruit face cream can help mitigate the aging process and is beneficial for treating burns and acne.

KEY WORDS: Acne, sunburn Dragon fruit, herbal cream, anti-aging

Introduction

Dragon fruit, also known as pitaya, is the fruit of several cactus species native to the Americas. Hylocereus polyrhizus and Hylocereus undatus are two common varieties of dragon fruit, both belonging to the Cactaceae family. Dragon fruit has gained popularity worldwide for its unique appearance and nutritional benefits. The fruit can weigh up to one kilogram and is characterized by its spiny exterior. The edible flesh can be either red or white, with the skin ranging from yellow to dark red, and contains numerous small, tasty black seeds.

Dragon fruit is rich in flavonoids, predominantly found in its skin, and phytoalbumins, valued for their potent antioxidant properties that help combat free radicals and delay the aging process, promoting taut, supple, and youthful-looking skin. It is also packed with essential vitamins such as C, B1, B2, and B3, along with minerals like calcium, phosphorus, and iron. High in fiber, niacin, protein, and comprising 80% water, dragon fruit is often referred to as a "super fruit" for its nutritional benefits and therapeutic properties.

Additionally, dragon fruit seeds contain unsaturated fats that can help reduce harmful cholesterol levels. The plant itself is known for its long-day nature, producing beautiful night-blooming flowers nicknamed the "Noble Woman" or "Queen of the Night." Dragon fruit is also recognized by various names including Strawberry Pear, Pithaya, Night Blooming Cereus, Belle of the Night, Conderellaconderella, and Jesus in the Cradle. The name "pitaya" derives from the bracts or scales on the fruit's skin, translating to "scaly fruit."

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Due to its ornamental value, particularly its large, creamy white flowers that bloom at night, dragon fruit is considered a fruit crop with significant potential for the future. Commercially grown in countries such as Israel, Vietnam, Taiwan, Nicaragua, Australia, and the United States of America, dragon fruit plants can continue to produce fruit for up to 20 years after planting, with approximately 800 fruits per hectare.

Botanical Classification

Dragon fruit belongs to the botanical family Cactaceae and the genus Hylocereus. This genus is primarily characterized by climbing vine cacti with aerial roots that produce attractive berries with large scales, as reported by Fournet (2002) [5]. Species within the Hylocereus genus are diploid (2n = 22) (De Dios, 2004; Lichtenzveig et al., 2000) [6,7]. There have been various discrepancies in the botanical classification of Hylocereus (Mizrahi et al., 1997; Daubresse-Balayer, 1999), likely due to similar morphological characteristics and environmental factors. The classification by Britton and Rose (1963) [6] was historically followed, but recent genetic analyses, including those by Tel-Zur et al. (2004) [8], have also been considered.

Dragon Fruit

Dragon fruit (Hylocereus polyrhizus), also known as pitaya, is extensively cultivated in tropical regions such as Central and South America, as well as in Southeast Asian countries like Malaysia, Vietnam, and Thailand. Recently, dragon fruit has gained attention as a new source of food ingredients due to its natural red-purple color, rich antioxidant content, high fiber, vitamin C, minerals, and phytoalbumins, which possess significant nutraceutical properties [9].

Figure 1: Dragon fruit

Medicinal Properties of Dragon Fruit

Antidiabetic Properties:

Diabetes mellitus, a prevalent systemic disease worldwide, is characterized by hyperglycemia resulting from pancreatic malfunction in insulin production or inadequate cellular sensitivity to insulin action (American Diabetes Association, 2009). Several medicinal plants like neem (Azadirachta indica), ivy gourd (Coccinia indica), bitter gourd (Momordica charantia), jamun (Syzygium cumini), aloe vera (Aloe barbadensis Miller), and chicory (Cichorium intybus) have demonstrated antidiabetic effects through mechanisms such as restoration of pancreatic β-cell function, enhanced insulin receptor sensitivity, insulin secretion stimulation, inhibition of hepatic gluconeogenesis, increased glucose absorption, and inhibition of glucose-6-phosphatase, β-amylase, and β-glucosidase activities (Ocvirk et al., 2013; Kooti et al., 2016; Adinortey et al., 2019) [10,11].

Antioxidant Activities:

There is growing interest in natural antioxidant substances derived from medicinal plants for their preventive role against cell damage caused by free radicals, implicated in various

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diseases including cancer (Young and Woodside, 2001). The medicinal popularity of many plants is attributed to the antioxidant properties of essential phenolic compounds such as flavonoids, phenolic acids, stilbenes, lignans, tannins, alkaloids, and vitamin C, which scavenge radicals (Pietta, 2000; Nyamai et al., 2017). Studies have linked antioxidant scavenging activity to the total phenolic content in plants, highlighting compounds like gallic acid (phenolic acid) and flavonoids (polyphenols) as key contributors to antioxidant efficacy (Bertoncelj et al., 2007; Wu and Ng, 2008; Nurliyana et al., 2010).

Antiviral and Antimicrobial Activity

The resistance of plants to various pathogens, including viruses, fungi, and bacteria, is primarily attributed to secondary metabolites synthesized post-microbial infection (García-Mateos and Pérez-Leal, 2003; Montes-Belmont, 2009; Hernández-Alvarado et al., 2018; Mickymaray, 2019). These metabolites, such as phytoanticipins (constitutively produced and stored in plant tissue) and phytoalexins (induced de novo in response to infection), play a crucial role in plant immunity (Müller and Börger, 1940; Van Etten and Bateman, 1981; Paton, 1951). Plants rich in bioactive compounds like flavonoids (flavones, flavonols, flavanols, isoflavones, anthocyanidins), terpenoids (sesquiterpene lactones, diterpenes, triterpenes, polyterpenes), steroids, phenolic acids (hydroxybenzoic, hydroxycinnamic acids), stilbenes, lignans, quinones, tannins, coumarins (simple coumarins, furanocoumarins, pyranocoumarins), alkaloids, glycosides, saponins, lectins, and polypeptides exhibit potent antimicrobial properties (Iwu et al., 1999; Chanda et al., 2010; Naseer et al., 2012; Fadipe et al., 2013; Umer et al., 2013; Taher et al., 2014; Mickymaray, 2019) [28, 29, 30, 31, 32, 33].

Wound Healing Activity

Wound healing is a complex biological process involving cellular responses, extracellular matrix deposition, and the action of growth factors and cytokines to restore tissue integrity (Velnar et al., 2009). Tsai et al. (2019) investigated the wound healing properties of ethanol-aqueous extracts from different parts of Hylocereus polyrhizus, including bark, stem, and flower. They conducted in vitro tests using the NIH-3T3 fibroblast cell line to assess cell migration ability in scratch assays. Results indicated that extracts from the pith and flower peel of dragon fruit, at a concentration of 1000 μg ml–1 in 95% aqueous ethanol, significantly promoted fibroblast migration within 24 hours, essential for wound healing processes. Additionally, these extracts demonstrated high antioxidant activity due to their phenolic and flavonoid content, which play roles in DNA protection and wound healing, with potential applications in pharmaceuticals, cosmetics, and food industries (Perez et al., 2020) [35].

Perez et al. (2020) further explored the wound healing potential of dragon fruit extracts using animal models. They applied various concentrations (0.05%, 0.1%, 0.2%, 0.4%, and 0.5%) of aqueous extract on cut and incision wounds in mice, twice daily for seven days. Their findings indicated significant wound healing effects, particularly from flower and leaf extracts of Hylocereus undatus, while pulp and bark extracts also exhibited wound healing properties, albeit to a lesser extent. Notably, flower extracts showed the most effective results in wound area reduction, underscoring their therapeutic potential (Perez et al., 2020) [36].

Hepatoprotective Activity

Recent research by Parmar et al. (2019) investigated the potential hepatoprotective effects of methanol extract from dragon fruit against liver damage induced by acetaminophen in rats. In this study, animals were administered acetaminophen (3 g kg-1 day-1, orally) for three days, along with different doses of dragon fruit methanol extract (300 and 500 mg kg-1, orally), and silymarin (200 mg kg-1, orally), a standard extract from Silybum marianum seeds used for comparative purposes. At the end of the treatment period, blood samples were collected for analysis of serum enzymes, and histological studies were conducted on sacrificed rats. Parmar et al. (2019) reported that dragon fruit extract exhibited antioxidant and

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hepatoprotective properties at both enzymatic and histological levels. It effectively restored levels of enzymes such as alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, total and direct bilirubin, lactate dehydrogenase, gamma-glutamyltransferase, and total protein. Moreover, oxidative stress parameters like malondialdehyde levels, reduced glutathione, and the activities of superoxide dismutase and catalase were normalized towards healthy levels comparable to silymarin treatment [39].

Cauilan (2019) also explored the hepatoprotective effects of crude and ethanolic extracts from H. polyrhizus fruits (2,500 mg kg–1 body weight) in rats challenged with tetrachloromethane (CCl4)-induced liver damage, comparing it with silymarin treatment. The study demonstrated that administration of H. polyrhizus extracts significantly reduced serum levels of glutamate-pyruvic transaminase and glutamate-oxaloacetic transaminase compared to both the control group (without dragon fruit extract) and the silymarin-treated group. This protective effect was attributed to the rich composition of antioxidants in dragon fruit, including triterpenes, flavonoids, glycosides, tannins, saponins, and alkaloids [39].

Cardiovascular Protective Activity

Cardiovascular diseases are a leading cause of mortality globally, with increased arterial stiffness posing a significant risk factor for adverse cardiovascular events. Studies have highlighted the potential of dragon fruit in mitigating oxidative stress-related conditions, largely due to its bioactive compounds, including potent antioxidants [40].

Eldeen et al. (2020) investigated the anti-inflammatory properties of dragon fruit pulp and peel from H. undatus, identifying beta-linens known for their strong radical scavenging activity. They also discovered the presence of squalene, a polyunsaturated hydrocarbon, as a dominant component in the fruit (13.2%). Their findings indicated that squalene exhibited inhibitory activity against pro-inflammatory enzymes such as 5-lipoxygenase, cyclooxygenase-2, and acetylcholinesterase, with effective concentration (EC50) values ranging from 46 to 47 μg ml–1. This study suggested that dragon fruit, through various mechanisms involving leukotrienes, prostaglandins, and cholinergic pathways, holds potential in managing neuronal and inflammatory conditions [41].

Antihyperlipidemic and Anti-obesity Effects

Hernawati et al. (2018) conducted a study to assess the impact of red dragon fruit peel powder (H. polyrhizus) on blood lipid levels in hyperlipidemic male Balb-C mice. Different groups of mice were fed varying doses of dragon fruit peel powder (ranging from 50 to 200 mg kg–1 body weight) for 30 days. Following the treatment period, blood samples were collected and analyzed for total cholesterol, triglycerides, and low-density lipoprotein cholesterol (LDL-c). The results indicated a dose-dependent reduction in these lipid parameters with increasing doses of red dragon fruit peel powder. The study highlighted that supplementation of dragon fruit peel powder in the diet could potentially mitigate hyperlipidemia due to its advantageous composition. Specifically, the high content of crude fiber (comprising 69.30% of total fiber, divided into 56.50% insoluble dietary fiber and 14.82% soluble dietary fiber) aids in reducing energy intake by trapping cholesterol and bile acids in the small intestine. Additionally, it improves insulin sensitivity and increases satiety. Furthermore, the antioxidants, phenols, and tocotrienols (vitamin E) present in dragon fruit peel powder were shown to reduce hepatic cholesterol levels and plasma concentrations of total cholesterol and LDL-cholesterol [37].

In a study by Suastuti et al. (2018) on the anti-obesity and hypolipidemic effects of methanol extract from H. costaricensis fruit pulp, obese rats administered the fruit pulp extract at a dose of 100 mg kg–1 body weight exhibited significant reductions in body weight, Lee's obesity index, organ weight, visceral fat weight, total cholesterol, low-density lipoprotein, triglycerides, very-low-density lipoprotein, and total cholesterol/high-density lipoprotein

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(HDL) ratio. Conversely, HDL-cholesterol, fecal fat, and cholesterol concentrations increased in these rats [38].

In conclusion, bioactive compounds found in dragon fruit extracts, including crude fiber, phenolics, polyphenols, and flavonoids, contribute to the modulation of serum lipid profiles. These antioxidants effectively inhibit cholesterol absorption in the intestine and promote its excretion in the stool, thereby aiding in the management of hyperlipidemia and obesity-related conditions [37, 38].

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