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Value Addition in Dragon Fruit: Opportunities for Processing and Entrepreneurship

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Dragon fruit, also known as Kamalam, has rapidly gained popularity because of its striking appearance, refreshing taste and nutritional value. Although the fruit is mainly consumed fresh, its commercial potential extends far beyond the fresh produce market. Like many horticultural commodities, dragon fruit is highly perishable and may lose quality during prolonged handling, transportation and marketing. Seasonal abundance can also result in lower market prices and post-harvest losses. Value addition provides an opportunity to overcome these limitations by converting fresh fruit into convenient, stable and marketable products. Dragon fruit pulp can be utilized for preparing fresh-cut products, beverages, dried slices, fruit powders, jams, jellies, fruit leather, canned products and several innovative foods. Advanced drying technologies can further facilitate the production of high-quality powders and dried snacks. Importantly, the peel and seeds, which are often discarded during processing, are also potential sources of natural pigments, dietary fibre, pectin and other useful components. Efficient utilization of these by-products can reduce waste and improve the overall profitability of dragon fruit processing. Thus, value addition can provide new opportunities for growers, processors and entrepreneurs while contributing to sustainable post-harvest management.

Introduction

Dragon fruit is an emerging fruit crop that has attracted the attention of consumers, growers and the food-processing industry in recent years. Its brightly coloured peel, distinctive scale-like bracts and attractive pulp filled with tiny black seeds give it a unique identity among tropical fruits. Both white- and red-fleshed types are commercially important, while the intense colour of red-fleshed dragon fruit makes it particularly appealing for the development of naturally coloured food products. Apart from its visual appeal, dragon fruit is valued for its nutritional and functional characteristics. The edible pulp provides carbohydrates, dietary fibre, minerals, vitamins and several naturally occurring bioactive compounds. Red-fleshed fruits are particularly rich in betalain pigments, which are responsible for their characteristic red-purple colour. Increasing consumer interest in colourful, nutritious and minimally processed foods has therefore contributed to the growing demand for dragon fruit. Despite its commercial potential, fresh dragon fruit has a limited marketing period. After harvest, the fruit continues to undergo changes such as moisture loss, softening, colour alteration and biochemical deterioration. Improper handling or extended storage can further increase the risk of microbial spoilage. At the same time, an abundant harvest during the peak season may result in excess market supply, making it difficult for growers to obtain favourable prices for the entire crop.

Processing provides an alternative route for utilizing such produce. Instead of marketing dragon fruit exclusively in fresh form, it can be transformed into a range of products that offer greater convenience and longer availability. Value addition can also provide an outlet for fruits that do not satisfy premium fresh-market requirements because of differences in size, shape or external appearance, provided that the fruits remain wholesome and suitable for processing. An additional opportunity lies in the utilization of processing residues. The peel represents a considerable portion of the fruit and is generally discarded along with seeds and other residues during processing. However, these fractions contain potentially useful constituents. Therefore, converting dragon fruit into value-added foods while simultaneously utilizing its by-products can increase the economic return obtained from the crop and contribute to more sustainable processing.

Fresh-Cut Dragon Fruit: Ready-to-Eat Convenience

Modern consumers increasingly prefer foods that require little preparation while still retaining fresh characteristics. This trend creates an excellent opportunity for marketing dragon fruit as a minimally processed product. Peeled fruit can be prepared as slices, cubes or bite-sized pieces and packed as a convenient ready-to-eat snack. Fresh-cut dragon fruit can be particularly suitable for supermarkets, hotels, cafeterias, institutional catering, fruit bowls and mixed-fruit packs. Consumers receive the advantage of enjoying the fruit without the need for washing, peeling and cutting. However, removal of the protective peel and cutting of the flesh expose internal tissues to the surrounding atmosphere. As a result, deterioration may proceed more rapidly than in intact fruit. Good sanitation, hygienic preparation, suitable packaging and continuous refrigeration are therefore important for maintaining quality. Properly designed packages can help minimize moisture loss and external contamination, while low-temperature storage slows metabolic activity and microbial development. Minimal processing consequently provides a relatively simple method of adding value while preserving the natural identity of dragon fruit.

Refreshing Beverages from Dragon Fruit

The soft and juicy pulp of dragon fruit makes beverage processing one of its most promising value-addition options. Juice can be prepared from both white- and red-fleshed types, although red-fleshed fruit offers an additional advantage because of its naturally appealing colour. Processing begins with the selection and cleaning of sound fruits, followed by peeling and separation of the edible portion. The pulp can then be crushed or pulped to obtain juice. Depending on the desired final product, coarse particles, seeds or excessive mucilage may be separated. Further operations such as homogenization and appropriate heat processing can be used to obtain a more uniform and microbiologically stable beverage. The usefulness of dragon fruit juice extends beyond its direct consumption. It can form the base for **ready-to-serve beverages, nectar, squash, smoothies, blended drinks and other refreshing products**. Combining dragon fruit with fruits having stronger flavour profiles can also lead to attractive beverage blends. Red dragon fruit has special potential in this category because its natural pigments provide a distinctive colour without relying entirely on artificial colouring agents. Such characteristics are increasingly relevant as consumers show greater interest in foods prepared with naturally derived ingredients. Beverage production can also provide an effective way of utilizing large quantities of ripe fruits within a relatively short period, making it particularly valuable during seasonal peaks.

Dried Dragon Fruit: A Convenient Shelf-Stable Product

The high moisture content responsible for the succulent texture of fresh dragon fruit also contributes to its perishability. Removing a substantial portion of this water offers an effective way to increase product stability. Drying additionally reduces the weight and volume of the fruit, which can simplify packaging, storage and transportation.

Dried Slices and Fruit Snacks

One of the simplest approaches is to convert dragon fruit flesh into dried slices or pieces. Sound fruits are peeled, cut uniformly and dehydrated until an appropriate moisture level is achieved. The resulting product can be consumed directly as a fruit snack or included in cereal mixtures, bakery products and other foods. The drying conditions strongly influence the final quality. Excessive temperature or prolonged heating may cause undesirable changes in colour, texture, aroma and heat-sensitive constituents. Therefore, appropriate combinations of temperature, air movement and drying time are required to obtain an acceptable product.

Transforming Dragon Fruit into Powder

Converting dragon fruit into powder can greatly broaden its range of applications. Powder is easier to handle than fresh fruit, requires less storage space and can be incorporated into different formulations without the difficulties associated with transporting highly perishable fresh produce.

Spray-Dried Powder

Spray drying provides one approach for converting dragon fruit juice or pulp into a fine powder. The liquid material is dispersed into very small droplets inside a drying chamber. Contact with heated air rapidly removes moisture, producing dry particles within a short period. Suitable carrier substances may be incorporated into fruit-based feeds to improve drying behaviour and powder characteristics. Red dragon fruit powder is particularly attractive because of its vivid natural colour. Depending on the processing conditions and final quality, the powder may be incorporated into **instant beverages, yoghurt, ice cream, confectionery, desserts, bakery products and other formulated foods.**

Fluidized-Bed Drying

Fluidized-bed technology represents another approach for preparing dehydrated dragon fruit. In this system, rapidly moving heated air passes through fruit pieces in such a manner that efficient contact occurs between the product and drying air. Improved heat and mass transfer can promote comparatively uniform moisture removal. The dried pieces obtained through this method can potentially be developed into fruit snacks or ingredients for breakfast cereals and convenience foods. Optimization of drying conditions is necessary to maintain desirable colour, flavour and texture.

Jam, Jelly, Fruit Leather and Other Familiar Foods

Dragon fruit pulp can be used in the preparation of **jam, jelly, fruit spreads and syrup**, either individually or in combination with other fruits. These products allow the fresh pulp to be converted into forms that consumers already recognize and use regularly. Fruit leather represents another interesting possibility. Dragon fruit puree can be spread as a thin layer and dehydrated to produce a flexible, concentrated fruit sheet. The finished product can be cut into convenient portions and marketed as a snack. The fruit can also be incorporated into **ice cream, yoghurt, cakes, cookies, confectionery, desserts and other bakery products.** Red-fleshed dragon fruit is particularly suitable for product innovation because its natural colour provides considerable visual appeal.

Beyond the Pulp: Turning Dragon Fruit Peel into a Resource

Value addition becomes even more meaningful when the portions normally discarded during processing are also utilized. Dragon fruit peel is one such promising resource. Peel accounts for a substantial proportion of the whole fruit and can accumulate rapidly in juice, fresh-cut and other processing operations. Disposing of this material not only represents a loss of potentially valuable constituents but also adds to organic waste. The intense red-purple colour of certain dragon fruit peels originates largely from betalain pigments. These naturally occurring colour compounds can potentially be recovered and utilized as ingredients in appropriately formulated foods. With growing demand for natural alternatives to synthetic colours, such applications may provide considerable future scope.

Peel can also be dried and converted into powder. Depending on its composition, safety and formulation requirements, peel powder may be explored as a fibre-rich functional ingredient in selected food products. Another important component is **pectin**, a polysaccharide widely employed by the food industry because of its gelling, thickening and stabilizing properties. Recovery of pectin from dragon fruit peel could create an additional product from processing residues.

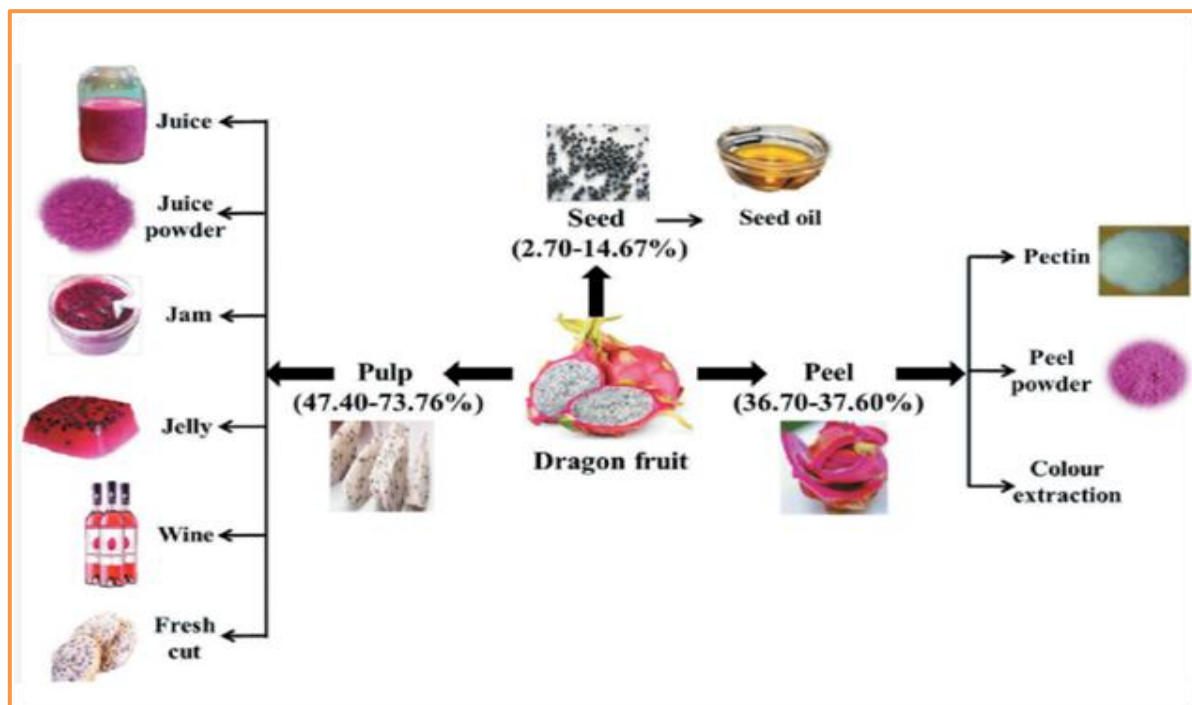


Fig. 1. Potential value-added products from dragon fruit pulp, peel and seeds.

Opportunities for Entrepreneurship and Income Generation

Value addition can play an important role in improving the economics of dragon fruit production. Fresh-market prices are influenced by season, supply, appearance and local demand. During peak harvesting periods, growers may face difficulty in marketing all fruits at favourable prices. Processing creates alternative marketing channels. Sound fruits that are unsuitable for premium fresh sale because of minor variations in appearance can potentially be diverted to appropriate processing operations. This can reduce wastage and generate income from produce that might otherwise receive a low market value. The opportunities also exist at different investment levels. Small-scale processors, self-help groups and farmer organizations may focus on products such as beverages, jam, jelly, fruit leather, dried slices and ready-to-eat fruit. Larger enterprises can explore spray-dried powders, freeze-dried snacks and other technologically advanced products.

Future Prospects

As dragon fruit cultivation expands, processing technologies need to develop alongside production. Future efforts should focus on simple, affordable technologies suitable for growers and small entrepreneurs as well as advanced methods capable of producing premium products for specialized markets. There is considerable potential for developing **natural colourants, functional ingredients, nutritious snacks, instant beverage powders and fibre-enriched foods** from dragon fruit and its by-products. Standardization of processing conditions and evaluation of product quality, storage stability and consumer acceptance will be important for successful

Conclusion

Dragon fruit should no longer be viewed only as a premium fruit for fresh consumption. Its unique colour, juicy pulp and versatile processing characteristics provide numerous opportunities for value addition. Fresh-cut products, beverages, dried slices, fruit powders,

canned products, jam, jelly, fruit leather, dairy products and confectionery. At the same time, the peel and seeds offer an additional dimension to dragon fruit processing. Recovering pigments, fibre, pectin and other useful components from these fractions can convert processing residues into valuable resources. Such utilization can improve profitability while reducing waste. Value addition can therefore connect **post-harvest loss reduction, product diversification, entrepreneurship and sustainable resource utilization**. As production increases, developing efficient processing and marketing systems will become increasingly important. With appropriate technologies and market support, dragon fruit has the potential to move well beyond the fresh-fruit shelf and become an important raw material for a diverse range of innovative food products.