Revolutionizing Guava Food Processing: A Fresh Perspective

Abstract

This study investigates the contemporary shift in guava processing paradigms, capitalizing on technological advancements, sustainable practices and value addition. Exploring novel methods, the research aims to revolutionize traditional guava processing by enhancing efficiency, quality and sustainability. Through the integration of cutting-edge techniques, the article envisions a transformative era in guava processing, fostering advancements in production and product utilization. This innovative approach responds to consumer demands for healthier, sustainable choices, promising a future in guava processing that aligns with dynamic global culinary preferences.

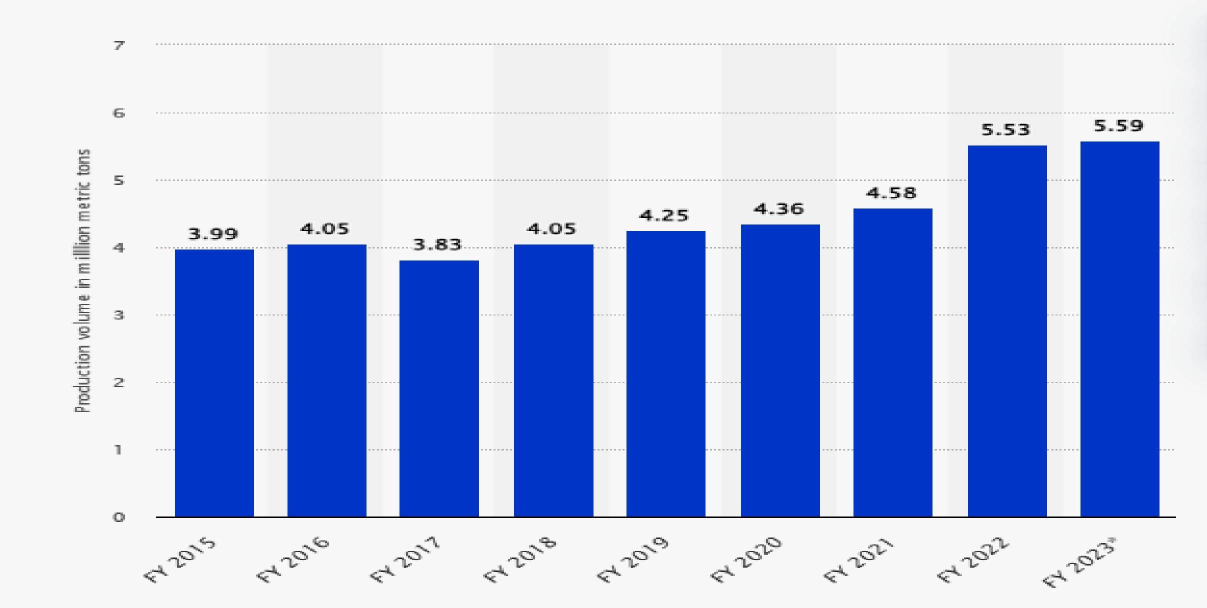
Keywords: Guava, value addition, processing andmarketing.

Introduction

In recent years, the world of food processing has witnessed a groundbreaking transformation and one of the most exciting developments is the revolution in guava food processing. This newfound approach brings with it a fresh perspective on how we handle this delicious and nutrient-rich tropical fruit (Ramos *et al.*, 2018).

Guava is a delicious and nutritious fruit that is found in most countries. This fruit thrives well in dry soil. The significance of guava lies in its nutritional properties and its economic importance due to its medicinal uses(Barbalho *et al.*, 2012). Guava fruit is naturally rich in nutrients, including vitamin C, vitamin A, vitamin B, fibre, calcium, potassium and phosphorus (Irshad *et al.*, 2020). Regular consumption of guava helps keep the body healthy, strengthens the immune system and improves digestion.

The processing and industrial productions of guava products are economically vital for farmers. Cultivating guava can bring good profits to farmers, improving their financial situation (Thaipong and Boonprakob, 2005). It also provides employment opportunities in rural areas, contributing to economic development. Guava leaves, seeds and peels are utilized to prepare various types of medical treatments (Uchoa-thomaz*et al.,* 2014), (Wang *et al.*,2016) and (Wang *et al.*, 2018). In India, guava is cultivated in Uttar Pradesh, Bihar, West Bengal, Chhattisgarh, Maharashtra, Tamil Nadu, Karnataka, Madhya Pradesh, Gujarat and Andhra Pradesh (Kumbhar *et al.,* 2014). In the 2019-20 period, the area under guava cultivation was 292 thousand hectares and the production reached 4,361 thousand metric tons. According to the National Horticulture Board, guava cultivation covered an area of 94 thousand hectares in 1991-92, which increased to 155,000 hectares in 2001-02. Meanwhile, production rose from 11 lakh tonnes to 17 lakh tonnes during this period (Anonymous, 2017). For the 2022-2023 fiscal year, the estimated guava production in India is 4.92 million metric tonnes, surpassing the previous financial year (Kumar *et al.*, 2019).



Graph-1:Production of guava
Source: Food and Agriculture Organization of United Nation (FAO)

As Food: Guava is health-promoting and sweet in taste when used as food. It is utilized in various forms such as fresh fruit, salad, chutneys, jams, jellies, fresh juice, puree and powder, among others. People widely enjoy it due to its believed health benefits (Verma *et al.*, 2013). There are around 400 varieties of guava found worldwide (Wijeratnam*et al.*, 2000). Several countries across the globe cultivate 10 to 12 different varieties of guava. India is the primary producer of guava, producing approximately 2.5 million tons of guavas annually. India contributes 45% of the world's guava production, followed by Indonesia, China and Mexico.
The Global Impact of Guava Production: Guava production is crucial for the global economy. It provides employment to many people and boosts the trade of agricultural products. Its production enhances economic prosperity in both local and international markets (Fernandez and Pelea, 2016). Additionally, its widespread health benefits lead to a broad usage, promoting the wellbeing of people and encouraging the growth of production facilities.
Challenges in Guava Production: Guava production faces several challenges. It is considered a tropical fruit and requires favourable climatic conditions for optimal productivity. Countries with tropical climates like India witness high guava production, while regions with colder climates experience lower yields. Additionally, in many countries, guava production may be good, but there may be a lack of proper processing facilities for the fruits(Dos Santos *et al.*, 2017).In India, the guava processing industry is progressing and developing expertise in manufacturing various guava-related products(Costa *et al.*, 2020). Efforts are being made through different industrial initiatives and research to improve the quality of guava products, leading to increased demand and preference in the market (Amutha *et al.*, 2016).
The development of the guava processing industry in India has not only increased production but has also provided employment opportunities to many individuals. The guava processing industry offers job opportunities to people with modest and middle-income levels, thereby improving their financial status (Kapoor *et al.*, 2020).
Traditional guava processing methods often involve manual labour, which can be time-consuming, labour-intensive and result in significant wastage. However, with the advent of

cutting-edge technologies and innovative techniques, the landscape of guava food processing has changed dramatically.

Guava Processing Industry in India: According to studies, the global market value of guava puree production was equivalent to 313.8 million rupees in 2017. The expected development rate of this market during the projected period from 2017 to 2025 is estimated to be 5.6:1. In the coming years, there is hope for the guava puree segment to maintain its prominence in the food industry (Serna-Cock *et al.,* 2016). The Asia-Pacific region is expected to experience the fastest growth rate from 2020 to 2025.

India is the largest producer and exporter of guava pulp. The market share for pink guava puree is 55.3%, while for white guava puree, it is 40%. The remaining 5% is shared among other variations. Furthermore, the lack of technology for guava processing has hindered the global development of the guava industry (Naphade*et al.*, 2008). However, in recent years, the advancement of excellent post-harvest techniques has benefited the food and beverage processing industry Araujo *et al.,* 2020).

Different Types of Guava Processing in India: White guava and pink guava are the most popular varieties processed in India. Guava processing here refers to the transformation of guava fruit into pulp or mash by removing the seeds and other characteristics. The processed guava is then used in various forms, such as fruit puree, paste, juice, sherbet, jelly, chutney, etc. White guava and pink guava are considered the main types in this industry(Shiva *et al.,* 2017).

The Allahabad Safeda and Sardar (Lucknow-49) varieties are the most extensively cultivated guava types in India and they undergo significant processing. The Safeda guava has a white-colored fruit with a white exterior skin, while the pink guava (Lalit) has a pink or pinkish-red fruit with a pink outer skin (Wang *et al.,* 2017). These varieties are preferred in the guava processing industry due to their size and quick ripening, making them popular in the market for their flavor and aroma (Todisco *et al.,* 2018).

India experiences two peak seasons for guava processing. The first season lasts from January to March when the weather is cool and the fruit production is high. The second season lasts from August to December when the weather is warm and the fruit production is relatively low. By maximizing production during both these seasons, guava processing factories in India meet the demand for guava products throughout the year.

Guava processing industry in India is driven by the growing demand from consumers in developed and developing nations due to increased income and urbanization. The industry benefits both producers and consumers. Primary guava processed products include guava puree, pulp and concentrate (Lima *et al.,* 2018). These primary processed products serve as a foundation for secondary guava products such as jellies, jams, marmalades, baked goods, sweets, beverages and cosmetic products containing fruit extracts (Omitoyin*et al.,* 2019).

The processed guava products find extensive use in food powders or squashes for making beverages, confectionery, dairy and bakery products (Chen and Yen, 2007). The industry is witnessing growth due to increased consumption of guava processed products in the confectionery and dairy sectors, as well as the development of the market for bakery fillings, puddings, ice cream mixes and baby fruit meals containing puree (Nobre *et al.,* 2020). In the beverage industry, guava puree and concentrate are added to the final products to enhance the special flavor and aroma of guava.

Firstly, advanced machinery and automation have taken center stage, streamlining the entire processing chain. Modern sorting machines can efficiently separate ripe guavas from unripe ones, ensuring that only the best fruits move forward in the process (Khaleel and Kumari, 2012). This not only optimizes production but also reduces food waste, making it an eco-friendly approach.

Modern lifestyle, increasing urbanization and rapidly changing eating habits are inspiring consumers to seek fresh and processed food products (Ciudad *et al.,* 2019). Currently, there is a growing demand for processed food products and guava puree plays a significant role in this. Guava puree is primarily used for fruit juice production, as it enhances the taste and quality of the juice more effectively than flavoring agents (Perez *et al.,* 2008).

Compared to other fruits, guava puree's popularity is rising, especially as a substitute for fresh fruits. The availability of fresh fruits is limited, but by processing guava into puree, its availability can be maintained throughout the year (Iha *et al.,* 2018). As a result, products made from guava puree are experiencing market growth and its future demand is also being predicted positively.

Due to this development, there is a plan to focus on developing ready-to-eat food products by guava processing industry producers. This will not only enhance their production but also attract consumers towards these prepared food items (Laily *et al.,* 2015).. It will also lead to an improvement in the taste of food products and make them more appealing to consumers.

Furthermore, breakthroughs in preservation techniques have significantly extended the shelf life of guava products. Innovations in vacuum packing and controlled atmosphere storage have helped retain the fruit's natural flavors, colors and nutritional value without the need for excessive artificial preservatives (Luo *et al.,* 2019).

Another vital aspect of this revolution is the focus on value-added products. Guava puree, nectar, juice concentrates and even dried guava snacks have gained popularity in the market. These products cater to diverse consumer preferences and expand the potential of guava as a versatile ingredient in the food and beverage industry.

Guava Pulp Processing Method: Guava fruits are collected from orchards and transferred to ripening chambers. The fruits are naturally ripened. Damaged guava fruits are separated using a conveyor belt for making pulp (Dos Santos *et al.,* 2018). To remove dirt, the fruits are washed with chlorinated water. The clean fruits pass through a fruit mill and the collected pulp is stored in a pulp collection tank. The guava pulp is then heated to 65-70 degrees Celsius. The guava pulp is separated from uneven pulp chunks in guava puree using a mesh strainer(Fitri*et al.,* 2019). To thicken the pulp, a vacuum evaporator chamber is used to remove the water content. Unwanted substances are removed from the pulp using a magnetic sieve, strainer and metal detector(Serna-Cock *et al.,* 2013).

Through the process of irradiation, guava puree is rid of pathogens and other biological particles, ensuring the absence of infections in the pulp (Castro-Vargas *et al.,* 2010). After cooling the puree, it is packed in aseptic bags with a polyliner and placed in membrane dryer drums. The temperature of the product is controlled in the warehouses to ensure the safe preservation of the puree for an extended period.

Complete set of Guava Pulp and Juice Production Line:

1. Washing Machine
2. Sorting Conveyor
3. Pulping Machine
4. Crusher
5. Tubular Pre-heater Pasteurizer
6. Cold/Hot Break System
7. Elevator
8. Vacuum/Continuous/Forced Circulation Evaporator
9. Filling Line:
    - Can Filling Machine
    - Bottle Filling Machine

- Sachet Filling Machine
- Aseptic Bag in Drum Filling Machine

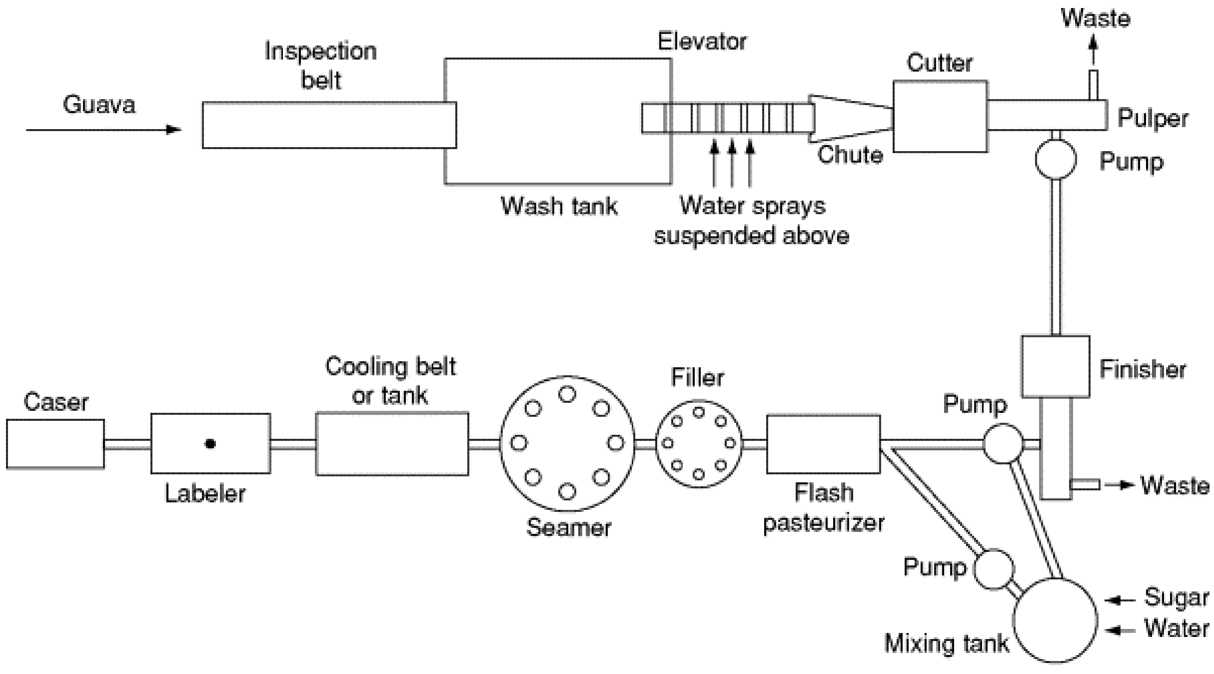


Figure 1 shows the flow sheet for the guava processing line (for frozen products, bypass pasteurization and cooling belt). Adapted from Boyle F, Seagrave-Smith H, Sakrata S and Sherman G (1957) Hawaii Agric. Exp. Stn., Bull. 111.

Guava Processed Products:

1. Guava Juice: Cut and peel guava fruits, extract the juice and mix it with sugar and water. Bottle the juice and store it in a cool place.
2. Guava Puree: Also known as guava pulp, it is a fragrant and thick substance made by processing fresh guava fruits. Guava puree retains the sweetness, taste and nutritional elements of fresh fruits. It is made from carefully selected guava fruits. In India, guava processing is equipped with advanced techniques and reliable production facilities to meet the demand in both domestic and international markets (Martinez *et al.*, 2012). Fruit juice industry is the primary consumer of guava puree.
3. Guava Marmalade: Peel and deseed guava fruits, cut them into small pieces. Mix them in a pot with sugar, water and lemon juice. When the mixture thickens, allow it to cool and then fill it in bottles.
4. Guava Jam: Peel and deseed guava fruits, finely chop them. Mix them in a pot with sugar, water and lemon juice. When the mixture sets, fill it into jam jars.
5. Guava Chutney: Peel and deseed guava fruits, cut them into small pieces. Blend them in a blender with green chilies, onions, coriander leaves, saltand lemon juice. Bottle the chutney and let it cool.
6. Guava Pickle: Peel and deseed guava fruits, cut them into small pieces. Mix them with salt, red chili powder, turmeric powder, mustard seeds and mustard oil. Bottle the pickle and let it cool.

The above-mentioned instructions can prove helpful for guava processing. Complete the process with cleanliness and hygiene and use clean, dry jars to preserve the products with high quality. It is essential to clean the guavas thoroughly and remove their seeds before further processing (Narvaez-Cuenca and Inampues-Charfuelan, 2020). After that, the guavas can be cut into pieces according to the desired size, making the preparation work for processing easier (Rojas-Garbanzo *et al.*, 2021).

Guava processing includes various methods such as making guava jam, marmalade, chutney and pickles. These products are made to be enjoyed for an extended period and can be sold in different markets.

Marketing channels for processed guava products, as per processing units, are outlined as follows:

(a) Large scale

(I) Producer → Preharvest contractor → Commission agent → ProcessingUnit → Commission and Forwarding agent → Wholesaler → Retailer → Consumer.

(II) Producer → Commission agent → Processing unit → Commission and Forwarding agent → Wholesaler → Retailer → Consumer.

(b) Small scale

(I) Producer → Pre-harvest contractor → Commission agent → Processing unit → Commission and Forwarding agent → Wholesaler → Retailer → Consumer.

(II) Producer → Commission agent → Processing unit → Commission and Forwarding agent → Wholesaler → Retailer → Consumer.

(c)Cottage scale

(I) Producer → Pre-harvest contractor → Commission agent → Processing unit → Commission and Forwarding agent → Consumers.

(II) Producer → Commission agent → Processing unit → Commission and Forwarding agent → Consumer.

Guava processing can lead to the creation of health-enhancing and safe products that can be used in other food products or consumed directly. Processing guava can increase the quantity of fruits and benefit farmers by fetching better prices.However, the guava processing industry in India faces several challenges. One significant challenge is the lack of appropriate technical knowledge and techniques (Liu *et al.*, 2014) and (Diaz-de-Cerio *et al.*, 2016). Proper processing techniques ensure the quality of products, but their absence can lead to lower estimated demand for the products, hindering industry growth. There is also a change in the preferences of guava consumers (Liu *et al.*, 2015). The market for guava products is becoming highly competitive, necessitating the use of appropriate products and the latest technologies in the industry.

Table.1: Processing of guava by processing units in the growing area.

S. No.	Category of Processing Unit	Average Capacity of 3 months (Qtl.)	Average Quantity of Guava Processed (Qtl.)	Capacity Utilization (%)
1	Cottage Scale	51.25	44.45	86.73
2	Small Scale	150.62	120.33	79.89
3	Large Scale	2312.82	2131.52	92.16
4	Aggregate	838.23	765.43	91.31

Additionally, sustainability has become a core principle in this new approach to guava food processing. Farmers are now encouraged to adopt eco-friendly cultivation practices, such as organic farming and water-efficient irrigation systems, to promote biodiversity and minimize environmental impact (Diaz-de-Cerio *et al.*, 2015).

Moreover, research and development have played a pivotal role in the continuous improvement of guava processing techniques. Scientists and food technologists are working hand in hand to develop innovative methods that enhance the nutritional profile of guava products (Pelegrini*et al.,* 2011). This includes fortification with essential vitamins, minerals and antioxidants, further elevating the fruit's health benefits.From a global perspective, this revolution in guava food processing has opened up new market opportunities for countries with favorable climates for guava cultivation. It has spurred economic growth and provided employment opportunities in regions where guava farming is a prominent livelihood(Flores *et al.,* 2015).

Conclusion

The development of guava processing industry in India is an important challenge at the global level. The industry needs to enhance its capabilities through appropriate technical knowledge, responding to changes in consumer preferences and improving product quality. Guava processing is not only a viable option for producers but also a suitable option for consumers (McCook-Russell *et al.,* 2012). It is an industry that evolves in tandem with the evolution of food products and changes in consumer habits and has the potential to guide future prosperity and growth. With advancements in technology, sustainability practices and value addition, this approach brings forth a new era of efficiency, quality and innovation in guava management. As consumers are looking for healthier and more sustainable food options, the future of guava processing looks really promising, with abundant potential to meet the ever-evolving culinary preferences of people around the world.

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