

# Evaluation of Guava Products Quality

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**Abstract** Fresh ripened Guavas were procured from entrepreneur's field and were weighed, sorted, washed, lye peeled before crushing and sieving to get guava pulp for preparation of different products such as RTS, Nectar and guava bar. Physico-chemical properties (Total Soluble Solids (TSS) Acidity, Ascorbic acid Content (AAC), Thermal properties, Particle Size analysis) and microbial properties (bacteria, yeast and mould) were studied for the products prepared. Thermal properties such as Thermal Conductivity (w/mk); Thermal diffusivity (mm<sup>2</sup>/s), Specific Heat Capacity (J/m<sup>3</sup>k) and Thermal Resistivity (mk/w) ranged between 0.319-0.640, 0.076-0.086, 4.170-7.459 and 1.562-3.136 respectively. Particle size of guava products varied from 301 to 1033 µm. Ascorbic acid content decreased with the decrease in TSS during product preparation. Microbial examination revealed that the product is safe to consume.

**Keywords** Guava, Physicochemical, Thermal Properties, RTS, Nectar, Microbial Load

## Practical Application

Guava is often marketed as "super-fruits" which has a considerable nutritional importance in terms of vitamins A and C with seeds that are rich in omega-3, omega-6 polyunsaturated fatty acids and especially dietary fiber, riboflavin, as well as in proteins, and mineral salts. The high content of vitamin C (ascorbic acid) in guava makes it a powerhouse in combating free radicals and oxidation that are key enemies that cause many degenerative diseases and that can be used to fortify children foods. Guava has wide applications such as ready to serve beverage, flavoring agent in candies and cakes, biscuits, chocolate bars, etc.

## 1. Introduction

Guava (*Psidium guajava* L.) is a member of the large Myrtaceae or Myrtle family, believed to be originated in Central America and the southern part of Mexico (Somogyi et al. 1996). It is claimed to be the fourth most important fruit in terms of area and production after mango, banana and citrus. India is the major world producer of guava (Jagtianiet al. 1998). It has been in cultivation in India since early 17th century and gradually became a crop of commercial importance. Guava is quite hardy, prolific bearer and highly remunerative even without much care. It is widely grown all over the tropics and sub-tropics including India viz., Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu, West Bengal, Assam, Orissa, Karnataka, Kerala, Rajasthan and many more states. Main Varieties

grown in India are *Allahabad Safeda*, *Lucknow 49*, *Chittidar*, *Nagapur Seedless*, *Bangalore*, *Dharwar*, *AkraMridula*, *ArkaAmulya*, *Harijha*, *Hafshi*, *Allahabad Surkha CISHG1*, *CISHG2*, *CISHG3* etc (NHB, 2010).

Guava is often marketed as "super-fruits" which has a considerable nutritional importance in terms of vitamins A and C with seeds that are rich in omega-3, omega-6 polyunsaturated fatty acids and especially dietary fiber, riboflavin, as well as in proteins, and mineral salts. The high content of vitamin C (ascorbic acid) in guava makes it a powerhouse in combating free radicals and oxidation that are key enemies that cause many degenerative diseases. The anti-oxidant virtue in guavas is believed to help reduce the risk of cancers of the stomach, esophagus, larynx, oral cavity and pancreas. The vitamin C in guava makes absorption of vitamin E much more effective in reducing the oxidation of the LDL cholesterol and increasing the (good) HDL cholesterol. The fibers in guavas promote digestion and ease bowel movements. The high content of vitamin A in guava plays an important role in maintaining the quality and health of eyesight, skin, teeth, bones and the mucus membranes.

With the changing consumer attitudes, demands and emergence of new market products, it has become imperative for producers to develop products, which have nutritional as well as health benefits. In this context, guava has excellent digestive and nutritive value, pleasant flavor, high palatability and availability in abundance at moderate price. The fresh fruit has limited shelf life therefore it is necessary to utilize the fruit for making different products to increase its availability over an extended period and to stabilize the price during the glut season. Guava can be consumed fresh or can be processed into juice, nectar, pulp, jam, jelly, slices in syrup, fruit bar or dehydrated products, as well as being used as an additive to other fruit juices or pulps (Leite et al. 2006).

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These products have good potential for internal as well as external trade. The utilization of guava for preparation of beverages and intermediates moisture products has not been explored much. Guava pulp can be used as base for the preparation of these products.

In the food industry, knowledge of the physical properties of food is fundamental in analyzing the unit operations. They influence the treatment received during the processing and good indicators of other properties as well as the qualities of food. These benefit the producer, industry and the consumer (Ramos and Ibarz, 1998).

Establishment of food processing industry in India is one of the best profitable businesses but due to non-availability of proper guidance and capacity-matching machinery makes this business unattractive to the investor. Small scale entrepreneurs and beginners require hands on experience before they invest in the procurement of the machinery and industry set up. Practical experience to run food processing plants will help in developing confidence in new entrepreneurs and analyze the actual facility required to establish the plant. Keeping above points in the mind, an existing pilot scale fruit processing facilities were ran at CIPHET, Ludhiana for

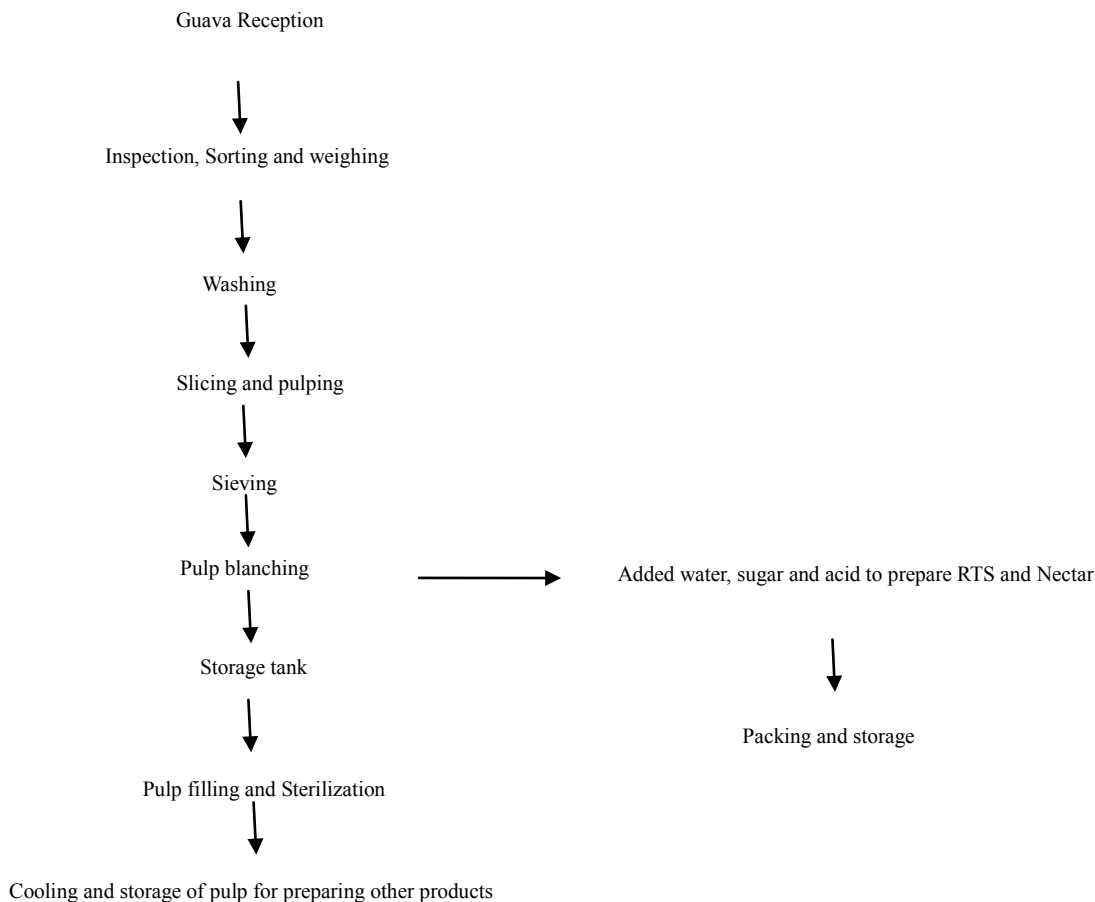
preparing different value added products from the guava.

## 2. Materials and Methods

Fresh ripened guavas of similar maturation grade were procured from the entrepreneur's farm located at Ludhiana, Punjab (India). Guava fruits were cleaned in tap water to remove surface dust and leaves before weighing, sorting and lye peeling. Existing pilot scale fruit processing facilities (100 Kg/hr) at CIPHET, Ludhiana were used.

### 2.1. Pilot Scale Processing Plant

Existing pilot scale fruit processing facilities at CIPHET, Ludhiana having an average capacity of 100Kg/hr has following equipments/machineries. Fruit washing tank (100 kg/hr), Fruit holding tank (100 Kg/hr), Fruit crusher (100 Kg/hr), Coarse Pulper (100 Kg/hr), Fine Pulper (75 Kg/hr), Blancher and holding Tank (200 Kg/hr), Concentrator (100 Kg/hr), Filling Machine (100 litre/hr), Manual Corking (200 bottles/ hr) and Autoclave/ bottle sterilizer (100 bottles/ batch).



**Figure 1.** Process Flow chart for preparation of value added Guava products

## 2.2. Sample Preparation

Good quality sound guava fruits were lye peeled by dipping in 2% sodium hydroxide solution at 80°C temperature for about 3 minutes. Lye peeled guava fruits were then neutralized with 1% citric acid solution before washing in tap water. The washed fruits were passed through a crusher/slicer to crush the fruit. The crushed fruit pulp mixture was fed into the coarse pulper (1.14 mm dia.) followed by fine pulper (0.84 mm dia.) to separate the seeds, fibrous pieces and pulp in a homogenized pattern through a perforated stainless steel screen. Guava pulp was extracted using cold extraction method. The guava fruit pulp was blanched in a steam blancher at 100°C temperature for 3 minutes and used for the preparation of products such as Guava RTS, Nectar and Squash.

## 2.3. Guava Product Preparation

The pulp was taken for preparation of guava juice, guava nectar and guava leather. A brief explanation for each product is given below along with the process flowchart (Fig 1). Guava Juice RTS was prepared using 12% of guava fruit pulp and pasteurized at 85°C for 3 min with the addition of sugar (12%) and citric acid (2.8g/l) and remaining volume was adjusted with water. For preparation of nectar, 20% guava pulp, 15% sugar, 2.5g/l citric acid and 65% water was used. Glass bottles filled with RTS and Nectar were subjected to sterilization for about 15 minutes at 121°C (15psi) to control the microbial load.

## 2.4. Determination of Physico-Chemical Properties

The physico-chemical properties such as Total Soluble Solids (TSS), Acidity, Ascorbic acid Content (AAC), Thermal Properties, Particle Size analyzer and Microbial Count of guava pulp (fresh and blanched), RTS and Nectar were determined as follows:

**TSS** - TSS value is defined as the amount of sugar and soluble minerals present in fruits. It is determined by the help of hand refractometer, which works on the principle of total refraction. A drop of the sample was placed on the plate to read the TSS in Brix.

**Percent Titratable Acidity** - Titratable Acidity of product is the acidity in terms of the predominant acid present in the juice i.e. citric acid. Titratable acidity was measured according to the method described by (Ranganna, 2001). The % titratable acidity was determined by taking 5ml of sample, adding 4 to 5 drops of 1 % phenolphthalein indicator and titrating with 0.1 N NaOH. The following formula was used to calculate the total acid, % (Ranganna, 2001).

$$\text{Total acid (\%)} = \frac{\text{Titre} \times \text{Equivalent weight of acid} \times 100}{\text{Volume of sample taken} \times 1000}$$

**Ascorbic Acid Content (Vit. C)** - Ascorbic Acid content was estimated by Iodine titration method (Suntornsuk et al. 2002). Ascorbic acid present in fresh and blanched guava pulp, guava juice, guava nectar and guava bar was determined. Sample of 10 ml was taken and made up to 100 ml volume with 3 % HPO<sub>3</sub> and filtered. Standard ascorbic acid

solution was prepared by taking 50 mg ascorbic acid and making up its volume up to 50 ml with 3 % HPO<sub>3</sub> solution; an aliquot of 5 ml from this solution was made up to 50 ml with 3 % HPO<sub>3</sub> solution. 42 mg of NaHCO<sub>3</sub> was dissolved in 150 ml hot distilled water. 50 mg of the dye, 2, 6- dichlorophenol indophenol was added in it and the volume was made up to 200 ml with distilled water to prepare the Dye solution. 5 ml of standard ascorbic acid solution was taken and mixed with 5 ml of 3 % HPO<sub>3</sub> solution. Dye was filled in a pipette and titration was done till a pink color appears that persists for at least 15 seconds. 5 ml of sample was blended with 50 ml of 3 % HPO<sub>3</sub> solution and filtered. 2 ml was taken from this solution and titrated against the dye. Dye Factor is 0.5/Titre.

The calculations were done with the help of the following formula (Rangana, 2001):

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Titre} \times \text{Dye Factor} \times \text{Volume made up} \times 100}{\text{Aliquot of extract taken} \times \text{Weight of sample taken}}$$

## 2.5. Thermal Properties

Thermal properties such as thermal conductivity, thermal diffusivity, specific heat capacity and thermal resistivity were determined using a thermal properties analyzer Type KD2, manufactured by (Decagon Devices Incorporation, USA). It was operating based on the line heat source method and the values were obtained directly from the digital read-out. Thermal conductivity was measured in intact guavas, pulp (Blanched, unblanched and homogenized) as well as in all the products made from it.

## 2.6. Particle Size Analysis

Particle size of guava pulp and various products prepared from it were analyzed with the help of Particle size distribution analyzer, LA-950V2 (Horiba, Japan). It works on the principle of laser scattering through the sample of known refractive index. Samples were dispersed in a solvent and passed through flow type cell unit for the analysis.

## 2.7. Microbial Analysis

The microbial load of the product was determined by checking the fungal and bacterial growth in the developed product for safety of the consumers. For Fungal and Bacterial load Mortin Rose Bengal agar [Peptone (5.0g), glucose (10.0g), KH<sub>2</sub>PO<sub>4</sub> (1.0g), MgSO<sub>4</sub> 7H<sub>2</sub>O (0.5g), Rose Bengal (0.035g) and agar (18.0g ) were dissolved in 1000 ml of distilled water] and standard plate count agar [Peptone/trypton (5.0g), yeast extract (2.5g), beef extract (2.0g), glucose (10.0g) and agar (18.0g) were dissolved in 1000 ml of distilled water/media were used respectively. Water blanks were prepared by 1g of sample to 10 ml of autoclaved water. For juice samples, the dilution was made up to 10<sup>-1</sup> and 10<sup>-2</sup> respectively for both enumerations of fungi and bacteria. From different dilutions made from different dilutions made of different products, 1ml was poured into each petridish followed by addition of 20-25ml of media. The petridish was circumvolved for proper mixing. The plates

were allowed to solidify and then kept in incubator at 37°C and 30°C for bacteria and fungi respectively. Colonies were counted after 72 h and 24 h for fungi and bacteria respectively.

The colonies were counted and were calculated as (Rangana, 2001). Colony Forming Unit (cfu)/ml = colonies counted  $\times$  reciprocal of dilution factor. The microbial analysis thus gave the measure of viable yeast and mold count and keeping quality of the guava juice.

### 2.8. Statistical Analysis

Physico-chemical properties and microbial load evaluation were carried out to check the effect of treatments and safety of food quality. Data was analysed as per one-way ANOVA, using LSD of AgRes Software statistical package.

## 3. Results and Discussion

Fresh ripened guavas harvested from entrepreneur's farm located at Ludhiana were used for preparation of different products and their properties were determined as follows:

### 3.1. Physico-Chemical Properties

Physico-chemical properties such as Total Soluble Solids (TSS), Acidity, Ascorbic acid Content (AAC) and particle size of guava products were studied and results were reported. TSS ranged from 7.0-7.5 °Brix in fresh pulp and 9-9.5 °Brix in steam blanched pulp (100°C temperature for 3 minutes). Acidity in fresh pulp varied from 0.29 to 0.34. Ascorbic acid content (mg/100g) was decreased with increase in the dilution varying as fresh guava pulp (41.5 mg/100g), guava pulp blanched (32.9 mg/100g), Guava

Nectar (8.086 mg/100g) and Guava RTS (2.56 mg/100g).

### 3.2. Thermal Properties

From Fig 2 it's clear that the Thermal properties such as thermal conductivity (w/mk) and thermal diffusivity ( $\text{mm}^2/\text{s}$ ) values are ranged between 0.319-0.640 and 0.076-0.086 respectively where as specific heat capacity ( $\text{J}/\text{m}^3\text{k}$ ) and thermal resistivity (mk/w) values are ranging between 4.170-7.459 and 1.562-3.136 respectively (Table 1). From Fig 3 it's clear that the specific heat and thermal conductivity showed linear dependency on water content and temperature i.e. it is increased with increasing temperature and decreased with decreasing total soluble solids. Similar results were also reported for tamarind juice concentrates (Manohar *et al.* 1991), clarified apple juice (Constenla *et al.* 1989) and Genipap Pulp (Da Silva *et al.* 2010).

From Fig 4 it is clear that the particle size of guava products varied from 301 to 1033  $\mu\text{m}$  for fresh pulp after homogenization and blanched pulp (without homogenization).

### 3.3. Microbial Load

The microbial load of the product was determined by checking the fungal and bacterial growth in the developed product for safety of the consumers. No fungal and bacterial infestation was detected in any of the processed guava products. Similar results were reported in foam-mat dried mango (Kadam *et al.* 2010). Therefore, the value added products prepared from guava in this study may be adjudged safe as far as national and international standards of microbial safety are concerned (Kadam *et al.* 2005; Kadam *et al.* 2009).

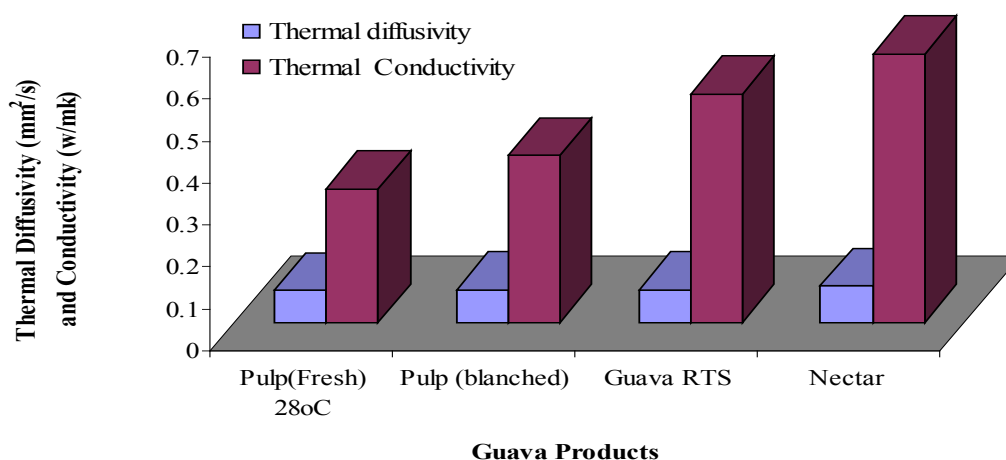


Figure 2. Thermal Conductivity and Thermal Diffusivity of Different Guava Products

Table 1. Thermal Properties of different guava products

Product	Temperature ( $^{\circ}\text{C}$ )	Thermal Conductivity (K), w/mk	Thermal diffusivity ( $\text{mm}^2/\text{s}$ )	Specific Heat Capacity ( $\text{J}/\text{m}^3\text{k}$ )	Thermal Resistivity (mk/w)
Pulp(Fresh)	25.35	0.2845	0.065	4.459	3.571
Pulp (blanched)	28.47	0.4275	0.081	5.257	2.350
Guava RTS	28.07	0.5235	0.078	6.703	1.915
Nectar	28.71	0.6270	0.088	7.094	1.595

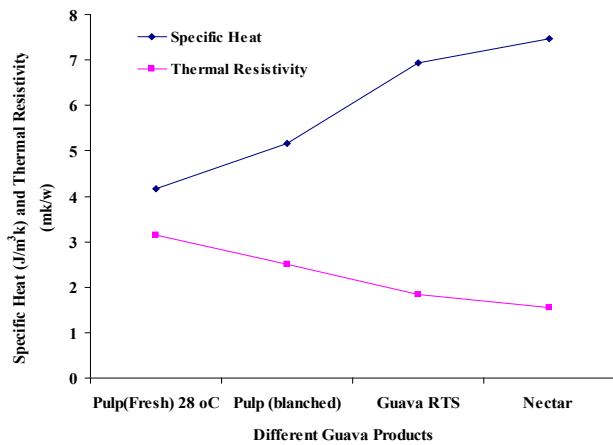


Figure 3. specific heat and thermal resistivity of different guava products

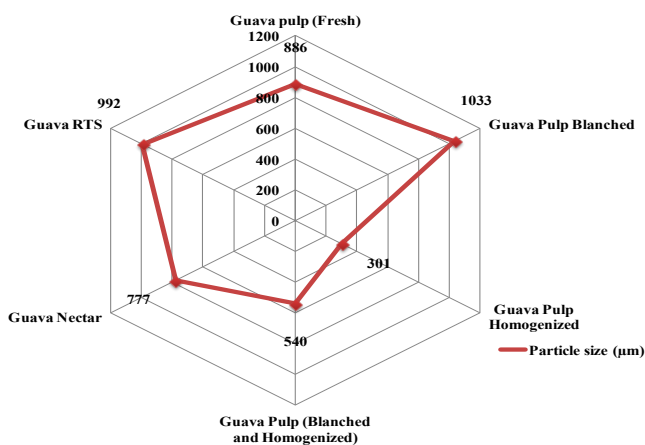


Figure 4. Particle size (µm) of different guava products

## 4. Conclusions

Since value addition and product diversification is of paramount importance in the present market scenario. More diversified products from Guava like RTS, nectar and guava leather/bar, have much importance. The developed products were excellent in taste, rich in nutritional quality, retained original fruit flavor and safe for consumption. Development of such nutritional products using pilot scale facilities will not only reduce the postharvest losses but also impart value to less appreciated fruits. Processed guava pulp can be converted in to a novel “guava leather/bar” product developed by CIPHET, Ludhiana/Abohar which will add 3-4 times value to the fruits. Therefore, manufacturing of such products will provide ample avenues for employment generation in the rural masses by way of setting small scale processing unit.

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