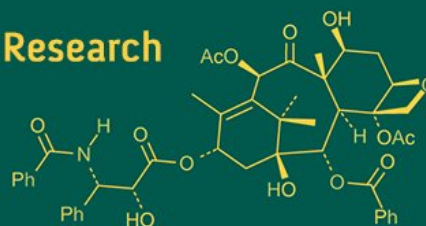
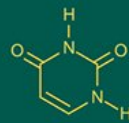


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## Development and quality evaluation of Pitaya berry (*Hylocereus polyrhizus*) pulp and peel jam

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### Abstract

The experiment entitled “Development and quality evaluation of Pitaya berry (*Hylocereus polyrhizus*) pulp and peel jam” was conducted during 2025–26 at the Horticulture Processing Laboratory, Department of Fruit Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The experiment was laid out in a Completely Randomized Design (CRD) with 12 treatment combinations and three replications. The treatments consisted of different proportions of pitaya pulp and peel combined with three levels of total soluble solids (66°, 68° and 70 °Brix), viz., T<sub>1</sub>: 100% pulp + 70 °Brix TSS, T<sub>2</sub>: 100% pulp + 68 °Brix TSS, T<sub>3</sub>: 100% pulp + 66°Brix TSS, T<sub>4</sub>: 80% pulp + 20% peel + 70°Brix TSS, T<sub>5</sub>: 80% pulp + 20% peel + 68 °Brix TSS, T<sub>6</sub>: 80% pulp + 20% peel + 66 °Brix TSS, T<sub>7</sub>: 60% pulp + 40% peel + 70 °Brix TSS, T<sub>8</sub>: 60% pulp + 40% peel + 68 °Brix TSS, T<sub>9</sub>: 60% pulp + 40% peel + 66 °Brix TSS, T<sub>10</sub>: 40% pulp + 60% peel + 70 °Brix TSS, T<sub>11</sub>: 40% pulp + 60% peel + 68 °Brix TSS and T<sub>12</sub>: 40% pulp + 60% peel + 66 °Brix TSS. Among the different treatment combinations, T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS) exhibited the best overall performance in terms of both quality and sensory parameters of freshly prepared jam. It recorded titratable acidity (0.57%), ascorbic acid (3.01 mg/100g), total sugar (68.94%), reducing sugar (29.97%), non-reducing sugar (38.97%), TSS:acid ratio (119.30) and Sugar:acid ratio (120.95). Among the sensory attributes, T<sub>5</sub> recorded the maximum scores for colour and appearance (9.10), taste (9.05), texture (9.15), flavour (9.45) and overall acceptability (9.02). Thus, based on its superior quality parameters and highest sensory scores, T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS) was identified as the best treatment for the preparation of good-quality pitaya berry pulp and peel jam.

**Keywords:** Pitaya berry, Jam, total soluble solids, quality parameters, sensory evaluation.

### Introduction

Dragon fruit (*Hylocereus polyrhizus*), belongs to the family Cactaceae, is native to Mexico, Central America and Northern South America. It is commonly known as pitaya or night-blooming cactus and is a fast-growing, evergreen climbing cactus. Vietnam is one of the leading exporters of dragon fruit, while its cultivation has expanded in several Indian states, including Karnataka, Kerala, Tamil Nadu, Maharashtra, Gujarat, Odisha, West Bengal and Andhra Pradesh (Karunakaran *et al.*, 2019) [6]. In India, red-skinned fruits with white pulp (*H. undatus*) and red-skinned fruits with red pulp (*H. polyrhizus*) are predominantly cultivated (Kakade *et al.*, 2020) [4].

Dragon fruit is valued for its nutritional and functional properties. The edible portion contains considerable amounts of moisture, protein, minerals, vitamin C, carbohydrates and dietary fibre (Le Bellec *et al.*, 2006). The fruit also possesses antioxidant and antimicrobial properties, while its peel and seeds are potential sources of micronutrients and bioactive compounds (Gunasena *et al.*, 2007). The red-fleshed species *H. polyrhizus* has also been reported to contain higher phenolic and antioxidant potential than white-fleshed dragon fruit. The peel, which may constitute nearly one-third of the total fruit weight, is generally considered a by-product of fruit processing but is rich in phenolic compounds, antioxidants, fibre and polysaccharides (Vaillant *et al.*, 2005) [23]. It therefore has considerable potential for value addition and can be utilized as a source of natural colour and functional ingredients. However, dragon fruit is highly perishable because of its high moisture content, delicate peel, rapid respiration and susceptibility to water loss and microbial deterioration. Consequently,

processing is essential to reduce post-harvest losses and extend its availability beyond the short harvesting season. Food processing provides an effective means of converting seasonal dragon fruit into value-added products such as jam, jelly, juice, nectar, squash and beverages. Dragon fruit contains approximately 0.20–1.04% pectin, which makes it suitable for jam and jelly preparation. Processing surplus fruit into jam can improve fruit utilization, reduce post-harvest losses and provide additional economic opportunities for growers and processors. Furthermore, incorporation of the nutrient-rich peel into jam can facilitate better utilization of the whole fruit and convert a processing by-product into a value-added food ingredient.

### Materials and Methods

The experiment was conducted during 2025-2026 at Horticulture Processing Laboratory, Department of Fruit Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, and Raipur (C.G.). Fresh, healthy and damage free pitaya berries were selected and washed thoroughly with clean water to remove dirt and other adhering impurities. The fruits were peeled carefully and the pulp and peel were separated. The pulp and peel were cut into small pieces and separately blended using a mixer grinder to obtain a uniform consistency. The pulp and peel were then mixed according to the different treatment combinations. For the preparation of pitaya berry pulp and peel jam, the pulp and peel mixture was heated with continuous stirring. Sugar was added as per the treatment details, and the mixture was cooked with continuous stirring. Citric acid and pectin were added at the appropriate stage of cooking. The jam was cooked until the desired total soluble solids level of 66°, 68°, or 70 °Brix, depending on

the treatment, was attained. The prepared jam was filled hot into pre-sterilized glass jars, sealed immediately with airtight lids and allowed to cool.

**Table 1:** Treatment details

| Treatments      | Pulp + Peel (%)     | Total soluble solids (°Brix) |
|-----------------|---------------------|------------------------------|
| T <sub>1</sub>  | 100% Pulp           | 70                           |
| T <sub>2</sub>  | 100% Pulp           | 68                           |
| T <sub>3</sub>  | 100% Pulp           | 66                           |
| T <sub>4</sub>  | 80% Pulp + 20% Peel | 70                           |
| T <sub>5</sub>  | 80% Pulp + 20% Peel | 68                           |
| T <sub>6</sub>  | 80% Pulp + 20% Peel | 66                           |
| T <sub>7</sub>  | 60% Pulp + 40% Peel | 70                           |
| T <sub>8</sub>  | 60% Pulp + 40% Peel | 68                           |
| T <sub>9</sub>  | 60% Pulp + 40% Peel | 66                           |
| T <sub>10</sub> | 40% Pulp + 60% Peel | 70                           |
| T <sub>11</sub> | 40% Pulp + 60% Peel | 68                           |
| T <sub>12</sub> | 40% Pulp + 60% Peel | 66                           |

### Total Soluble Solids (°Brix)

The pulp juice of Pitaya berry fruits was extracted separately by passing it through a muslin cloth. The Total Soluble Solids (TSS) content of the pulp was determined using an ERMA hand refractometer (58-90 °Brix) at room temperature, and the values were expressed as °Brix.

### Titrateable acidity (%)

Titrateable acidity of pitaya berry pulp was determined according to the method described by Ranganna (1986) [18]. The prepared sample was titrated against 0.1 N NaOH using phenolphthalein as an indicator until a persistent faint pink end point was obtained. The acidity was expressed as percentage (%) and calculated using the following formula:

$$\text{Acidity (\%)} = \frac{\text{Titre} \times \text{Normality of alkali} \times \text{Vol. made up} \times \text{Eq. wt. of acid} \times 100}{\text{Vol. of sample taken for estimation} \times \text{Wt. of sample taken} \times 1000}$$

### Ascorbic acid (mg/100g)

Ascorbic acid content of Pitaya berry pulp was determined according to the method described by Ranganna (1986) [18] using 2,6-dichlorophenol-indophenol dye. The pulp extract

was prepared in 3% metaphosphoric acid and titrated against the standard dye solution until a light pink end point was obtained. The ascorbic acid content was expressed as mg per 100g of pulp and calculated using the following formula:

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up} \times 100}{\text{Aliquot of extraction taken} \times \text{volume of sample}}$$

### Reducing sugar (%)

Reducing sugar content of Pitaya berry pulp was estimated by titration against Fehling's solution. For analysis, 25 ml of filtered pitaya berry pulp extract was transferred to a volumetric flask and diluted with distilled water. The sample was neutralized with an alkali solution, followed by the addition of 2 ml lead acetate solution. After thorough mixing and allowing the solution to stand, 2 ml potassium oxalate solution was added to clarify the extract. Equal

volumes (5 ml each) of Fehling's solution A and B were transferred into a conical flask and heated. The clarified pitaya berry extract was gradually added from a burette, followed by the addition of 1–2 drops of methylene blue indicator. The solution was heated intermittently while continuing the titration until a brick-red colour appeared, which indicated the endpoint. The reducing sugar content was expressed as percentage and calculated using the following formula:

$$\text{Reducing sugar (\%)} = \frac{\text{Invert sugar (mg)} \times \text{dilution} \times 100}{\text{Titre} \times \text{wt. or volume of the sample} \times 1000}$$

### Total sugar (%)

The total sugar content of Pitaya berry pulp was determined by the Lane and Eynon (1923) [11] method. About 50 ml of

the pulp extract was taken in a 100 ml volumetric flask, followed by the addition of 5 ml concentrated HCl, and the solution was allowed to stand at room temperature for 24

hours for inversion of sugars. The hydrolysed solution was neutralized with NaOH using phenolphthalein as an indicator and the volume was adjusted to 100 ml with distilled water. The resulting solution was titrated against Fehling's solution A and B mixed in equal proportions,

$$\text{Total sugars (\%)} = \frac{\text{Invert sugar (mg)} \times \text{Dilution} \times 100}{\text{Titre} \times \text{wt. or volume of the sample} \times 1000}$$

### Non-reducing sugar (%)

The non-reducing sugar content of pitaya berry pulp was calculated from the values obtained for total sugar and reducing sugar. It was determined by deducting the reducing sugar percentage from the corresponding total sugar percentage. The results were expressed as percentage (%).

$$\text{Non-reducing sugar (\%)} = \text{Total sugar (\%)} - \text{Reducing sugar (\%)}$$

### TSS:acid ratio

The TSS:acid ratio of Pitaya berry pulp was determined by dividing the total soluble solids (TSS) content by the titratable acidity, following the method described by Ranganna (1986)<sup>[18]</sup>. The results were expressed as a ratio.

$$\text{TSS:acid ratio} = \frac{\text{Total soluble solids (°Brix)}}{\text{Titratable acidity (\%)}}$$

### Sugar:acid ratio

The Sugar:acid ratio of Pitaya berry pulp was determined according to the method described by Ranganna (1986)<sup>[18]</sup> by dividing the total sugar content by the titratable acidity. The results were expressed as a ratio.

$$\text{Sugar: acid ratio} = \frac{\text{Total sugar (\%)}}{\text{Titratable acidity (\%)}}$$

## Results and Discussion

### A) Quality parameters of Pitaya berry pulp and peel jam

The quality parameters of Pitaya berry pulp and peel jam was evaluated with respect to total soluble solids (°Brix), titratable acidity (%), ascorbic acid (mg/100g), total sugar (%), reducing sugar (%), non-reducing sugar (%), TSS:acid ratio and Sugar:acid ratio. The results obtained for these parameters are presented in Tables 2 (a) to 2 (b) and are graphically illustrated in Fig 1 (a) to 1 (b).

### Total Soluble Solids (°Brix)

The total soluble solids (TSS) of freshly prepared pitaya berry pulp and peel jam were maintained according to the treatment specifications at 70, 68 and 66 °Brix. Statistical analysis indicated that the treatments had a non-significant effect on TSS, suggesting that the desired TSS levels were successfully achieved during jam preparation irrespective of the pulp and peel proportions.

### Titratable Acidity (%)

A significant variation of titratable acidity content of Pitaya berry pulp and peel jam was observed among the treatments. At the time of preparation (0 day), T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS) exhibited the minimum titratable acidity

using methylene blue as the indicator. The endpoint was indicated by the development of a brick-red colour. The total sugar content was expressed as percentage and calculated using the following formula:

(0.57%), which was found statistically *at par* with T<sub>2</sub> and T<sub>1</sub>, having acidity percentage of 0.59 and 0.60%, respectively. However, the maximum titratable acidity (0.88%) was recorded under the treatment T<sub>12</sub> (40% pulp + 60% peel + 66 °Brix TSS). The treatments containing higher proportions of peel exhibited comparatively higher acidity than those containing a greater proportion of pulp. This trend may be attributed to the naturally higher organic acid content present in the peel, which contributed to the overall acidity of the jam. Similar observations were reported by Gaur *et al.* (2005)<sup>[2]</sup> in ber jam.

### Ascorbic Acid (mg/100g)

The ascorbic acid content was significantly influenced by the different treatments evaluated under the present investigation. The maximum ascorbic acid content (3.01 mg/100g) of pitaya berry pulp and peel jam was observed under the treatment T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS), which showed non-significant differences with the treatments T<sub>2</sub> and T<sub>3</sub> having the respective ascorbic acid content of 2.97 and 2.93 mg/100g. The minimum ascorbic acid content (1.76 mg/100g) was registered under the treatment T<sub>12</sub> (40% pulp + 60% peel + 66 °Brix TSS).

A gradual decline in ascorbic acid content was noticed with the increase in peel proportion. This reduction may be due to the comparatively lower vitamin C content in the peel and the susceptibility of ascorbic acid to oxidation during thermal processing. Similar findings have been reported by Kanwal *et al.* (2017)<sup>[5]</sup> in guava jam and Kiranmai *et al.* (2017)<sup>[7]</sup> in tamarind and mango blended jam.

### Total Sugar (%)

The total sugar content of freshly prepared pitaya berry pulp and peel jam differed significantly among the treatments. the maximum total sugar content (68.94%) was recorded under the treatment T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS), which was statistically non-significant with the treatments T<sub>1</sub>, T<sub>4</sub>, T<sub>3</sub> and T<sub>2</sub> having the total sugar content of 66.93, 67.48, 67.92 and 68.41%, respectively. The minimum total sugar content (63.61%) was observed under the treatment T<sub>12</sub> (40% pulp + 60% peel + 66 °Brix TSS).

In general, total sugar content decreased as the proportion of peel increased. This may be due to the lower concentration of natural sugars in the peel compared to the pulp, resulting in reduced overall sugar content in the final product. Similar observations were reported by Safdar *et al.* (2012)<sup>[19]</sup> in mango jam and Nisa *et al.* (2018)<sup>[13]</sup> in Pitaya berry jam.

### Reducing Sugar (%)

The reducing sugar content of freshly prepared Pitaya berry pulp and peel jam varied significantly among the treatments. The maximum reducing sugar content (29.97%) was recorded under the treatment T<sub>5</sub> (80% pulp + 20% peel + 68

°Brix TSS), which was found *at par* with the treatment T<sub>3</sub> and T<sub>2</sub> having the respective reducing sugar content of 29.16 and 29.54%. The minimum reducing sugar content (25.67%) was recorded under T<sub>12</sub> (40% pulp + 60% peel + 66 °Brix TSS) under the present study. In general, reducing sugar content decreased with an increase in peel proportion, indicating that pulp contributed more readily available sugars than peel. Similar findings were reported by also Krishna *et al.* (2023) <sup>[9]</sup> in guava papaya mixed jam and Rafique *et al.* (2023) <sup>[16]</sup> in karonda jam.

#### Non-reducing Sugar (%)

Non-reducing sugar content of freshly prepared Pitaya berry pulp and peel jam ranged from 37.94% to 38.56% and was found to be non-significant among the treatments. The maximum non-reducing sugar content (38.97%) was recorded under the superiority of treatment T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS), followed by T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>1</sub>, T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>, T<sub>9</sub>, T<sub>10</sub> and T<sub>11</sub> having the respective non-reducing sugar content of 38.87, 38.76, 38.65, 38.56, 38.49, 38.42, 38.34, 38.25, 38.14 and 38.06. The minimum non-reducing sugar content (37.94%) was observed under the treatment T<sub>12</sub> (40% pulp + 60% peel + 66 °Brix TSS). The higher non-reducing sugar content observed in T<sub>5</sub> might be due to comparatively lower inversion of sucrose into reducing sugars during processing. In fruit jam, prolonged heating in the presence of organic acids promotes hydrolysis of sucrose into glucose and fructose, resulting in a decrease in non-reducing sugar content. Similar findings were reported by Koli (2004) <sup>[8]</sup> in sapota jam and Sawant *et al.* (2009) <sup>[21]</sup> in kokum pineapple blended jam.

#### TSS:acid ratio

The TSS:acid ratio differed significantly among the treatments. The maximum TSS:acid ratio (119.30) was recorded in T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS), which was found non-significant with T<sub>1</sub> having the TSS:acid ratio of 116.67. In contrast the minimum TSS:acid ratio (75.00) was observed in T<sub>12</sub> (40% pulp + 60% peel + 66 °Brix TSS).

The ratio gradually decreased as the peel content increased because of the corresponding increase in titratable acidity. The higher value in T<sub>5</sub> may be due to the optimum combination of pulp proportion and TSS level, which increased the concentration of total soluble solids, while reducing titratable acidity during processing. Similar observations were reported by Saravanan *et al.* (2004) <sup>[20]</sup> in papaya jam.

#### Sugar:acid ratio

A significant variation in Sugar:acid ratio were observed among the treatments. The maximum Sugar:acid ratio (120.95) was recorded under the supremacy of treatment T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS), which was found to be significantly superior from rest of the other treatments, while the minimum value (72.28) was recorded in T<sub>12</sub> (40% pulp + 60% peel + 66 °Brix TSS).

Treatments containing higher pulp proportions recorded higher Sugar:acid ratios, whereas increasing the peel proportion reduced the ratio due to higher acidity and lower sugar content. Similar findings were reported by Pavlova *et al.* (2013) <sup>[15]</sup> in raspberry and peach jam and Khan *et al.* (2012) <sup>[10]</sup> in strawberry jam.

#### B) Sensory parameters of Pitaya berry pulp and peel jam

The organoleptic evaluation was carried out for all the sensory parameters such as colour and appearance, taste, texture, flavour and overall acceptability of Pitaya berry pulp and peel jam and the results are presented in Table 3 and illustrated graphically in Fig. 2.

#### Colour and appearance

The data for colour and appearance scores of Pitaya berry pulp and peel jam were significantly influenced by different recipe treatments. The maximum colour and appearance score (9.10) was recorded under the superiority of treatment T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS), which showed non-significant difference with the treatment T<sub>2</sub> having the colour and appearance score of 8.90, whereas the minimum score (7.86) was observed in T<sub>10</sub> (40% pulp + 60% peel + 70 °Brix TSS). The variation in colour and appearance may be attributed to the combined effect of peel incorporation and TSS on the visual quality of the jam. Treatment T<sub>5</sub> obtained the highest score, indicating that incorporation of 20% peel improved the appearance and retained the desirable natural colour of the product. Similar findings were reported by Relekar *et al.* (2011) in sapota jam and Vidya and Narain (2011) <sup>[24]</sup> in woodapple jam.

#### Taste

The taste scores of Pitaya berry pulp and peel jam varied significantly under various recipe treatments. The maximum taste score (9.05) was recorded under the treatment T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS), which was found non-significant with the treatments T<sub>2</sub>, T<sub>3</sub>, T<sub>6</sub>, T<sub>4</sub>, T<sub>1</sub>, T<sub>8</sub>, T<sub>11</sub>, T<sub>7</sub> and T<sub>9</sub>, having the taste scores of 8.87, 8.85, 8.84, 8.83, 8.82, 8.81, 8.75, 8.70 and 8.68, respectively. The minimum taste score (7.76) was observed in T<sub>10</sub> (40% pulp + 60% peel + 70 °Brix TSS). The superior taste score in T<sub>5</sub> may be attributed to the optimum balance of pulp, peel, sweetness and acidity, resulting in better sensory acceptability. Similar findings were reported by Patel *et al.* (2015) <sup>[14]</sup> in pineapple and banana blended jam and Kanwal *et al.* (2017) <sup>[5]</sup> in guava jam.

#### Texture

The data revealed significant variation in the texture scores of Pitaya berry pulp and peel jam among different recipe treatments at 0 day of storage. The maximum texture score (9.15) was recorded under the excellency of treatment T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS), which was found significant differences with the treatments T<sub>2</sub>, T<sub>3</sub>, T<sub>6</sub>, T<sub>4</sub>, T<sub>1</sub>, T<sub>8</sub>, T<sub>11</sub>, T<sub>7</sub>, T<sub>9</sub> and T<sub>12</sub>, having the texture scores of 8.67, 8.65, 8.57, 8.52, 8.50, 8.45, 8.43, 8.35, 8.32 and 8.25, respectively, under the present investigation. However, the minimum texture score (7.65) was observed under treatment T<sub>10</sub> (40% pulp + 60% peel + 70 °Brix TSS), which was significantly inferior to all the other treatments under the study. The superior texture in T<sub>5</sub> may be attributed to the optimum incorporation of peel, which contributed natural pectin and dietary fibre, thereby improving gel formation and consistency. In contrast, higher peel incorporation may have increased fibre content and resulted in a coarse texture with lower acceptability. Similar findings were reported by Panchal *et al.* (2018) in Pitaya berry pulp and peel jam and Souad (2012) <sup>[22]</sup> in watermelon rind jam.

### Flavour

The flavour scores of Pitaya berry pulp and peel jam varied significantly among different recipe treatments. The maximum flavour score (9.45) was recorded in T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS), which was significantly superior to the other treatments, while the minimum score (7.65) was observed in T<sub>10</sub> (40% pulp + 60% peel + 70 °Brix TSS). The higher flavour score in T<sub>5</sub> may be attributed to the optimum balance of sweetness, acidity and natural fruit flavour, along with the contribution of desirable flavour compounds from moderate peel incorporation. Similar findings were reported by Khan *et al.* (2012)<sup>[10]</sup> in strawberry jam and Gaur *et al.* (2005)<sup>[2]</sup> in ber jam.

### Overall acceptability

The significant variation in the overall acceptability of Pitaya berry pulp and peel jam was observed among different recipe treatments at 0 day of storage. The maximum overall acceptability score (9.02) was recorded in T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS), whereas the minimum score (7.36) was observed in T<sub>10</sub> (40% pulp + 60% peel + 70 °Brix TSS). The higher acceptability of T<sub>5</sub> may be attributed to the optimum balance of sweetness, flavour, colour and consistency achieved through moderate peel incorporation. Similar findings were reported by Teixeira *et al.* (2020) in orange peel-incorporated orange jam and Afoakwa *et al.* (2006)<sup>[11]</sup> in pineapple.

**Table 2:** Effect of different recipes on quality parameters of freshly prepared Pitaya berry pulp and peel jam

| Notations       | Treatments          | Total soluble solids (°Brix) | Titrateable acidity (%) | Ascorbic acid (mg/100g) | Total sugar (%)        |
|-----------------|---------------------|------------------------------|-------------------------|-------------------------|------------------------|
| T <sub>1</sub>  | 100% Pulp           | 70                           | 0.60 <sup>ab</sup>      | 3.01 <sup>a</sup>       | 66.93 <sup>defgh</sup> |
| T <sub>2</sub>  | 100% Pulp           | 68                           | 0.59 <sup>a</sup>       | 2.97 <sup>ab</sup>      | 68.41 <sup>gh</sup>    |
| T <sub>3</sub>  | 100% Pulp           | 66                           | 0.63 <sup>c</sup>       | 2.93 <sup>ab</sup>      | 67.92 <sup>fgh</sup>   |
| T <sub>4</sub>  | 80% Pulp + 20% Peel | 70                           | 0.62 <sup>bc</sup>      | 2.89 <sup>b</sup>       | 67.48 <sup>efgh</sup>  |
| T <sub>5</sub>  | 80% Pulp + 20% Peel | 68                           | 0.57 <sup>a</sup>       | 2.86 <sup>b</sup>       | 68.94 <sup>h</sup>     |
| T <sub>6</sub>  | 80% Pulp + 20% Peel | 66                           | 0.67 <sup>c</sup>       | 2.74 <sup>c</sup>       | 66.47 <sup>cdefg</sup> |
| T <sub>7</sub>  | 60% Pulp + 40% Peel | 70                           | 0.75 <sup>d</sup>       | 2.61 <sup>d</sup>       | 65.98 <sup>bcdef</sup> |
| T <sub>8</sub>  | 60% Pulp + 40% Peel | 68                           | 0.78 <sup>e</sup>       | 2.45 <sup>e</sup>       | 65.51 <sup>abcde</sup> |
| T <sub>9</sub>  | 60% Pulp + 40% Peel | 66                           | 0.80 <sup>de</sup>      | 2.28 <sup>f</sup>       | 65.04 <sup>abcd</sup>  |
| T <sub>10</sub> | 40% Pulp + 60% Peel | 70                           | 0.85 <sup>de</sup>      | 2.09 <sup>g</sup>       | 64.57 <sup>abc</sup>   |
| T <sub>11</sub> | 40% Pulp + 60% Peel | 68                           | 0.86 <sup>e</sup>       | 1.93 <sup>h</sup>       | 64.08 <sup>ab</sup>    |
| T <sub>12</sub> | 40% Pulp + 60% Peel | 66                           | 0.88 <sup>e</sup>       | 1.76 <sup>i</sup>       | 63.61 <sup>a</sup>     |
|                 | SE (m) ±            | NS                           | 0.01                    | 0.03                    | 0.78                   |
|                 | C.D. at 5%          |                              | 0.03                    | 0.11                    | 2.30                   |

**Note:** (1) NS: Non- significant

(2) The superscript letters signifies that the treatment means with similar letters are at par at 5% level of significance, while the means with different letters are significantly different at 5% level of significance. These letters have been affixed based on CD-value comparison of treatment means

**Table 2:** Effect of different recipes on quality parameters of freshly prepared Pitaya berry pulp and peel jam

| Notations       | Treatments          | Reducing sugar (%)   | Non-reducing sugar (%) | TSS: Acid ratio      | Sugar: Acid ratio    |
|-----------------|---------------------|----------------------|------------------------|----------------------|----------------------|
| T <sub>1</sub>  | 100% Pulp           | 28.37 <sup>efg</sup> | 38.56                  | 116.67 <sup>gh</sup> | 111.55 <sup>f</sup>  |
| T <sub>2</sub>  | 100% Pulp           | 29.54 <sup>hi</sup>  | 38.87                  | 115.25 <sup>g</sup>  | 115.95 <sup>g</sup>  |
| T <sub>3</sub>  | 100% Pulp           | 29.16 <sup>ghi</sup> | 38.76                  | 104.76 <sup>f</sup>  | 107.81 <sup>e</sup>  |
| T <sub>4</sub>  | 80% Pulp + 20% Peel | 28.83 <sup>fgh</sup> | 38.65                  | 112.90 <sup>g</sup>  | 108.84 <sup>ef</sup> |
| T <sub>5</sub>  | 80% Pulp + 20% Peel | 29.97 <sup>i</sup>   | 38.97                  | 119.30 <sup>h</sup>  | 120.95 <sup>h</sup>  |
| T <sub>6</sub>  | 80% Pulp + 20% Peel | 27.98 <sup>def</sup> | 38.49                  | 98.51 <sup>e</sup>   | 99.21 <sup>d</sup>   |
| T <sub>7</sub>  | 60% Pulp + 40% Peel | 27.56 <sup>cde</sup> | 38.42                  | 93.33 <sup>d</sup>   | 87.97 <sup>c</sup>   |
| T <sub>8</sub>  | 60% Pulp + 40% Peel | 27.17 <sup>bcd</sup> | 38.34                  | 87.18 <sup>c</sup>   | 83.99 <sup>bc</sup>  |
| T <sub>9</sub>  | 60% Pulp + 40% Peel | 26.79 <sup>abc</sup> | 38.25                  | 82.50 <sup>b</sup>   | 81.30 <sup>b</sup>   |
| T <sub>10</sub> | 40% Pulp + 60% Peel | 26.43 <sup>abc</sup> | 38.14                  | 82.35 <sup>b</sup>   | 75.96 <sup>a</sup>   |
| T <sub>11</sub> | 40% Pulp + 60% Peel | 26.02 <sup>ab</sup>  | 38.06                  | 79.07 <sup>ab</sup>  | 74.51 <sup>a</sup>   |
| T <sub>12</sub> | 40% Pulp + 60% Peel | 25.67 <sup>a</sup>   | 37.94                  | 75.00 <sup>a</sup>   | 72.28 <sup>a</sup>   |
|                 | SE (m) ±            | 0.39                 | NS                     | 1.55                 | 1.33                 |
|                 | C.D. at 5%          | 1.15                 |                        | 4.65                 | 3.98                 |

**Note:** NS: Non- significant

**Table 3:** Effect of different recipes on sensory parameters of freshly prepared Pitaya berry pulp and peel jam.

| Notations       | Treatments          | Colour and appearance | Taste              | Texture           | Flavour              | Overall acceptability |
|-----------------|---------------------|-----------------------|--------------------|-------------------|----------------------|-----------------------|
| T <sub>1</sub>  | 100% Pulp           | 8.53 <sup>bcd</sup>   | 8.82 <sup>bc</sup> | 8.50 <sup>b</sup> | 8.65 <sup>bcde</sup> | 8.34 <sup>bc</sup>    |
| T <sub>2</sub>  | 100% Pulp           | 8.90 <sup>de</sup>    | 8.87 <sup>bc</sup> | 8.67 <sup>b</sup> | 8.92 <sup>e</sup>    | 8.48 <sup>c</sup>     |
| T <sub>3</sub>  | 100% Pulp           | 8.68 <sup>cd</sup>    | 8.85 <sup>bc</sup> | 8.65 <sup>b</sup> | 8.85 <sup>de</sup>   | 8.43 <sup>bc</sup>    |
| T <sub>4</sub>  | 80% Pulp + 20% Peel | 8.59 <sup>bcd</sup>   | 8.83 <sup>bc</sup> | 8.52 <sup>b</sup> | 8.70 <sup>cde</sup>  | 8.38 <sup>bc</sup>    |
| T <sub>5</sub>  | 80% Pulp + 20% Peel | 9.10 <sup>e</sup>     | 9.05 <sup>c</sup>  | 9.15 <sup>c</sup> | 9.45 <sup>f</sup>    | 9.02 <sup>d</sup>     |
| T <sub>6</sub>  | 80% Pulp + 20% Peel | 8.62 <sup>bcd</sup>   | 8.84 <sup>bc</sup> | 8.57 <sup>b</sup> | 8.78 <sup>cde</sup>  | 8.41 <sup>bc</sup>    |
| T <sub>7</sub>  | 60% Pulp + 40% Peel | 8.38 <sup>bc</sup>    | 8.70 <sup>bc</sup> | 8.35 <sup>b</sup> | 8.47 <sup>bcd</sup>  | 8.23 <sup>bc</sup>    |
| T <sub>8</sub>  | 60% Pulp + 40% Peel | 8.48 <sup>bc</sup>    | 8.81 <sup>bc</sup> | 8.45 <sup>b</sup> | 8.60 <sup>bcde</sup> | 8.28 <sup>bc</sup>    |
| T <sub>9</sub>  | 60% Pulp + 40% Peel | 8.33 <sup>bc</sup>    | 8.68 <sup>bc</sup> | 8.32 <sup>b</sup> | 8.40 <sup>bc</sup>   | 8.14 <sup>b</sup>     |
| T <sub>10</sub> | 40% Pulp + 60% Peel | 7.86 <sup>a</sup>     | 7.76 <sup>a</sup>  | 7.65 <sup>a</sup> | 7.65 <sup>a</sup>    | 7.36 <sup>a</sup>     |

|                 |                     |                    |                    |                   |                      |                    |
|-----------------|---------------------|--------------------|--------------------|-------------------|----------------------|--------------------|
| T <sub>11</sub> | 40% Pulp + 60% Peel | 8.41 <sup>bc</sup> | 8.75 <sup>bc</sup> | 8.43 <sup>b</sup> | 8.55 <sup>bcde</sup> | 8.25 <sup>bc</sup> |
| T <sub>12</sub> | 40% Pulp + 60% Peel | 8.25 <sup>ab</sup> | 8.67 <sup>b</sup>  | 8.25 <sup>b</sup> | 8.30 <sup>b</sup>    | 8.13 <sup>b</sup>  |
|                 | SE (m) ±            | 0.14               | 0.12               | 0.14              | 0.13                 | 0.11               |
|                 | C.D. at 5%          | 0.41               | 0.35               | 0.42              | 0.38                 | 0.33               |

**Note:** The superscript letters signifies that the treatment means with similar letters are at par at 5% level of significance, while the means with different letters are significantly different at 5% level of significance. These letters have been affixed based on CD-value comparison of treatment means

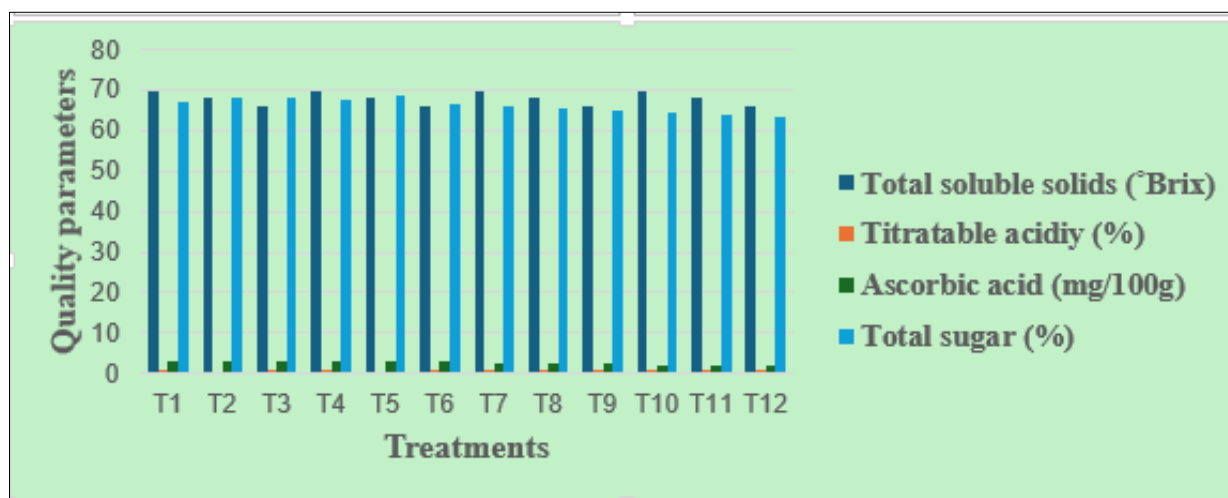


**Fig 1:** Effect of different recipes on quality parameters of freshly prepared Pitaya berry pulp and peel jam

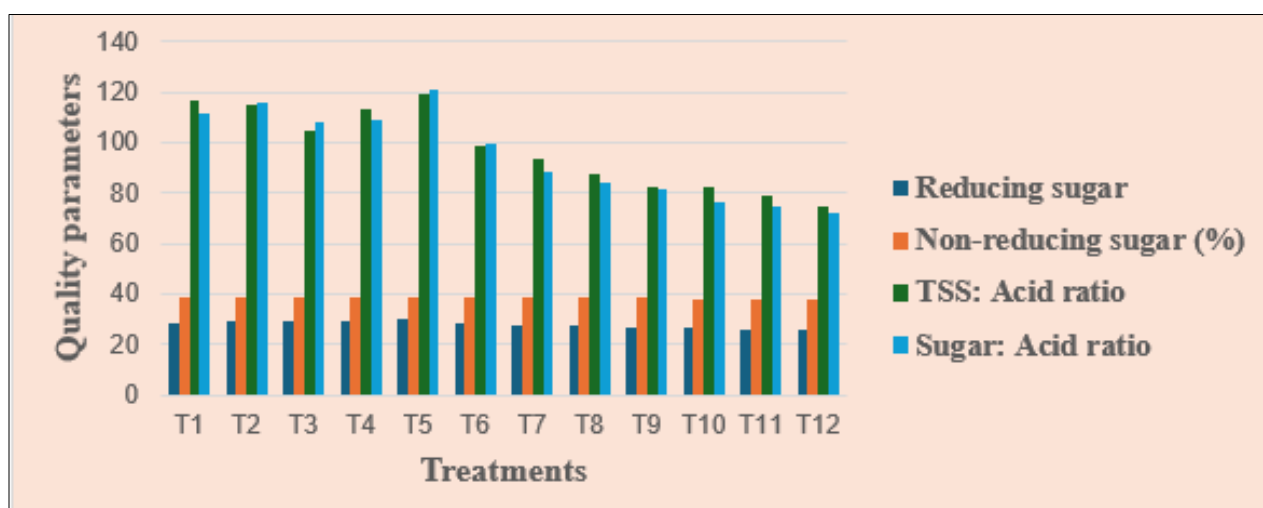


**Fig 2:** Effect of different recipes on quality parameters of freshly prepared Pitaya berry pulp and peel jam

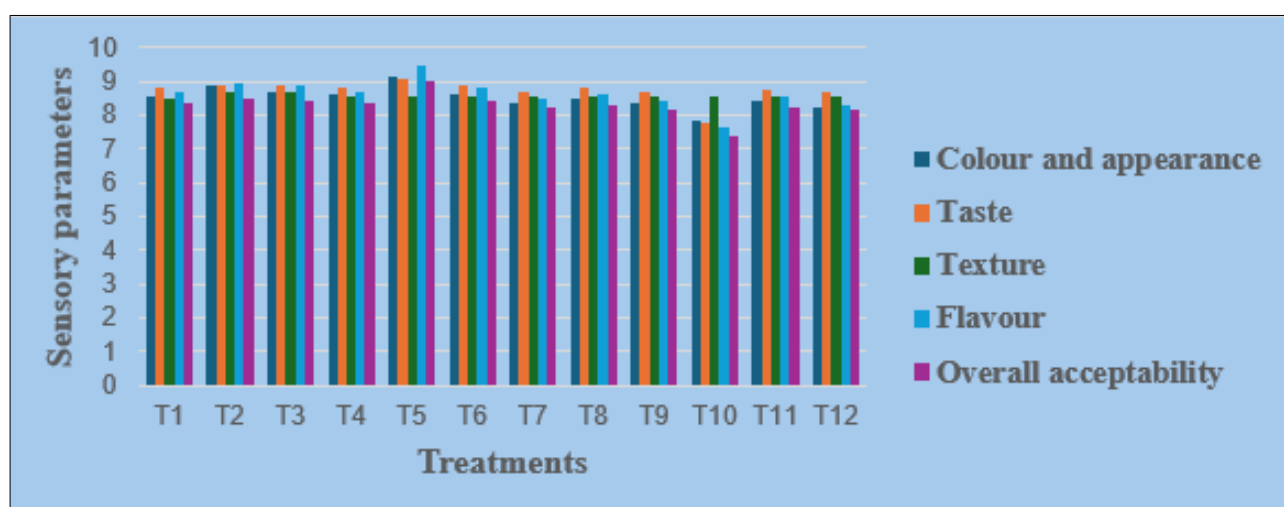


**Fig 3:** Effect of different recipes on sensory parameters of freshly prepared Pitaya berry pulp and peel jam

## Conclusion

The present investigation on the standardization of recipe and quality evaluation of Pitaya berry pulp and peel jam revealed that incorporation of peel had a significant influence on the quality and sensory parameters of the product. Among the different recipe treatments, T<sub>5</sub> (80% pulp + 20% peel + 68 °Brix TSS) emerged as the most promising treatment, recording the maximum ascorbic acid (3.01 mg/100g), total sugar (68.94%), reducing sugar (29.97%), non-reducing sugar (38.97%), TSS:acid ratio (119.30) and sugar:acid ratio (120.95). It also exhibited the maximum sensory scores for colour and appearance (9.10), taste (9.05), texture (9.15), flavour (9.45) and overall acceptability (9.02), indicating superior consumer acceptability. Therefore, the use of 80% pitaya pulp and 20% peel at 68 °Brix TSS can be considered the most suitable recipe for preparation of good-quality, acceptable and value-added pitaya berry pulp and peel jam. The utilization of peel further contributes to the effective conversion of a processing by-product into a value-added food product, thereby offering potential for commercial fruit processing and entrepreneurship.

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