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Nutritional Assessment of Guava for Quality Jelly Production

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Abstract:
Guava (*Psidium guajava* L.) is a Vitamin C (ascorbic acid) rich fruit. Its production is quite high in Bangladesh but post-harvest life is very short. Farmers will benefited by producing different guava products like juice, jelly etc. and selling them to market for year round. The current study has been carried out to observe the nutritional composition of fresh guava, guava juice, and jelly for nutritive jelly production. Shelf life and sensory evaluation of guava and guava jelly were also evaluated. Fresh green guava of four varieties (Swarupkathi Peyera, Kazi Peyera, BAU-2 Peyera and BAU-19 Peyera) were collected from the Germplasm Center, Patuakhali Science and Technology University (PSTU), Bangladesh. The shelf-life (mean value) of fresh Guava, Guava juice, and Jelly were about 11, 9, and 142 days in ambient condition; 24, 30, and 213 days in refrigerated condition; and 42, 142, and 325 days in freezing condition, respectively. Kazi Peyara confined the highest percentage of ascorbic acid (195.59 mg/100g FW), total sugar (10.65 % FW), calcium (17.45 mg/100g), and phosphorus (34.63 mg/100g). However, BAU-19 Peyara contains the highest percentage of magnesium (20.15 mg/100g) and BAU-2 Peyara contains the highest percentage of potassium (392.1 mg/100g). The mean ascorbic acid content in guava juice (29.23 mg/100ml) and jelly (17.65 mg/100gm) were significantly lower compared to the fresh guava (192.77 mg/100gm) and also the ascorbic acid loss during storage was significant. The average score of different sensory parameters for fresh guava and guava Jelly were within the standard range. From the results, it can be concluded that guava is a good source of nutrients and quality jelly could be prepared from it.

Keywords: Shelf-life, Sensory parameters, Ascorbic acid, Minerals, guava

1.0. Introduction

Because of the highest vitamin C (299 mg/100g) content among the table fruits, Guava is one of the most important defending fruit in Bangladesh [1]. In Bangladesh, the annual production is about 45,000 m. tons in an area of about 10,000 ha [2]. But, sorrowfully, guava growers fail to get attractive returns and nearly 20-25% of produce goes as damage [3]. It is very widespread as fresh fruit because of its excellent taste, medicinal properties, and hundred percent edibility. This fruit is equally compatible with the processing industry [4]. It is also a good source of pectin which has industrial use for jelly production [5]. As it is a tropical fruit, it exhibits rapid ripening and has a short shelf-life. Once they are ripe, they are only at their peak for about two days [6]. As it is a summer season fruit, for high temperature and humidity there is also a lot of spoilage during marketing [7]. Further, the availability of Guava fruit is abundant during the season creates a surplus in the market, and due to this Guava fruit sell at a minimal rate. The inhibition of losses of the seasonal surplus of the fruit by processing and preservation at farmer's level and as well as industrial-scale should be justified. Such efforts will support the development of processing industries in the growing areas of Bangladesh [8]. Therefore, this study was conducted to prepare Guava juice and jelly to avoid quality deterioration due to spoilage and to bring the higher value of produce during excess in the market.

2.0. MATERIALS AND METHODS

2.1. Study site

The experiment was done in the Post-harvest Technology and Marketing Laboratory, Agricultural Chemistry Laboratory, and Central Laboratory, Patuakhali Science and Technology University, Bangladesh.

2.2. Materials and experiment design

The experimental materials guava was collected from the Germplasm Centre of Patuakhali Science and Technology University (PSTU). The guavas were carefully chosen in order to obtain optimum maturity. Four guava varieties were chosen for this study, and these are S1= Swarupkathi Peyara, S2= Kazi Peyara, S3=BAU-2 Peyara, and S4=BAU-19 Peyara. The S1, S2, and S4 were collected in the mature stage where the S3 was collected in the immature stage. The laboratory assessment was done by following a Completely Randomized Design (CRD) with three replications. Three analytes were prepared from each replication for analysis of physic-chemical properties of the samples.

2.2. Shelf-life Study

Sample S1, S2, S3, S4 were stored T1= ambient condition (room temperature) at 25^{0}C, T2= refrigeration condition at 1.6^{0}C and T3= freezing condition at -18^{0}C, with 90-95% relative humidity. The samples were observed daily for visual determination of shelf-life and also at the end of the shelf life; the changes in quality during storage in different conditions were analyzed.

2.3. Sensory Quality

Guava varieties and prepared Guava Jelly were evaluated organoleptically by a panel of 10 judges as per the method described by a group of researchers [9]. Certain numerical scores were given by the panelists to evaluate the color, texture, taste, flavor, and absence of defects of the guava varieties and then compared the value with BSTI given ranges.

2.4. Extraction of Guava Juice

Guava juice was extracted following the method outlined by a researcher [10]. Fresh Guava was weighted and washed thoroughly in cold water. The washed guava was cut into several small pieces with a stainless steel knife. Then 1 kg of guava pieces was boiled in 1 liter of water. The boiled pieces were crushed and strained through a thick cloth to remove the suspended matter consisting of fruit tissue, seed, skin, gums and protein in colloidal form. The extracted juice was analyzed and then preserved in a deep freeze at -18^{0}C for future use.

2.5. Preparation of guava jelly

Guava jelly was prepared by the method outlined by a researcher [11]. The extracted guava juice has been used to prepare the guava Jelly. The amount of guava juice, water, acid, and sugar was calculated according to the formulation. The pulp, pectin, water, and small amount of calculated sugar were then mixed and for 3-5 minutes under agitation. Heating was continued and the rest of the sugar was then added. The endpoint is indicated by 67-68 percent Total Soluble Solids (TSS) in the mixture is determined by Refractometer. The Jelly was then filled in a glass jar. It was then covered with melted wax and cooled. After cooling the cans or jars are labeled and stored for further studies.

2.6. Chemical analysis

The fresh sample of matured guava, guava juice, and guava Jelly was analyzed to determine moisture, pH, TSS, reducing sugar, non-reducing sugar, total sugar, Vitamin-C (ascorbic acid), titrable acidity, and minerals content. For Chemical analysis, all the determinations were done three times, and the results were expressed as mean ± standard deviation.

2.7. Moisture content

Moisture content was determined by adopting a researchers method [18]. Moisture content was calculated using the following formula:

Moisture Content (%)= $\frac{\text{IW}-\text{FW}}{\text{IW}} * 100$

Where,

IW = Initial weight of the sample

FW= Final weight of the oven-dried sample

2.8. pH

The pH was determined by using a glass electrode pH meter (pH meter-211, HANNA). Guava fruits were sliced and squeezed with two-layer muslin cloths to extract the juice. The fruits were blended properly by a blender and used to determine the pH. The pH meter was calibrated before use with buffers at pH 4.0 followed by pH 7.0. Then, the glass electrode was placed into the filtrate to quantify the pH, and the stabilized reading was noted. For ensuring the precision of the reading, the glass electrode was cleaned with distilled water after each reading and dry with soft tissue paper.

2.9. Total sugar

The sugar content of fruit juice was assessed by the procedures designated by Lane and Eynon [12]. Then, the total sugar was estimated by using the following formula,

Total sugar (%) = Reducing sugar (%) + Non-reducing sugar (%)

2.10. Ascorbic acid (Vitamin C)

Ascorbic acid was determined according to the dye method described by a researcher [12]. The ascorbic acid content was calculated by using the following formula,

Ascorbic acid (mg/100gm) = $\frac{Titre\ (mL) \times dye\ factor \times vol.made\ up \times 100}{Aliquot\ used\ for\ estimation\ (5\ mL) \times sample\ weight\ (10\ g)}$

Where, Dye Factor =$\frac{0.5}{Titrate}$

2.11. Titratable Acidity (TA)

Titratable acidity (TA) was analyzed using the titration method described by Ranganna (2000).

The ascorbic acid content was calculated by using the following formula:

Titratable acidity (%) =$\frac{Titre * Normality\ of\ NaOH * Volume\ made\ up\ (ml) * Equivalent\ weight}{Volume\ of\ extract\ (ml) * Weight\ of\ sample\ (g) * 1000} * 100$

2.12. Total soluble solids (TSS)

The total soluble solids of extracted juice was estimated by using Abbe Refractometer (Model: DR-A1-Plus). A drop of guava juice was kept on the prism of the Refractometer. Then, the TSS (&) was noted from the scale of the Refractometer.

2.13. Minerals analysis (Wet Basis)

Calcium (Ca) and Magnesium (Mg) of fresh Guava and Guava Jelly were determined by the complexometric method of titration by using Na_2-EDTA as a complexing agent (Page et al., 1982). Then Phosphorus (P) and Potassium (K) content were determined by following the method as designated by a researcher [13].

2.14. Statistical Analysis

Statistical analysis was done by using Statistical Package for Social Science (SPSS) for Windows (version 25.0) and Minitab17. The results obtained in the experiment were reported as mean value (obtained from the three replications) ± standard deviation (SD). The significant differences between the mean values were analyzed by the Tukey HSD test at a significance level of 5%.

3. Results and Discussion

3.1. Physicochemical properties of fresh Guava

A two-way between-groups analysis of variance (ANOVA) was conducted (α=0.05) to explore the impact of storage conditions and varieties on the shelf-life of fresh Guava in days. Samples are four varieties (S_1, S_2, S_3, S_4) and kept in three different conditions (T_1, T_2, T_3). The interaction effect between varieties and storage condition was statistically significant, F (6, 24) = 2.9, p =0.028, η^2 = 0.42. There was a statistically significant difference among the varieties, F (3, 24) = 62.5, p =0.001, η^2 = 0.89 and also differ in storage conditions, F (2, 24) = 4335, p = 0.001, η^2 = 0.99. Post-hoc comparisons using the Tukey HSD test indicated that the shelf-life of fresh guava was significantly different ($p<0.001$) from each other storage conditions and also the shelf-life was differed among the varieties (the only exception, there is no significant difference between S_1 & S_3 and S_2 & S_3). Figure 1 shows that S_2 had the highest shelf-life in the T_1 condition, S_1 & S_2 in the T_2 condition and S_2 in the T_3 condition.

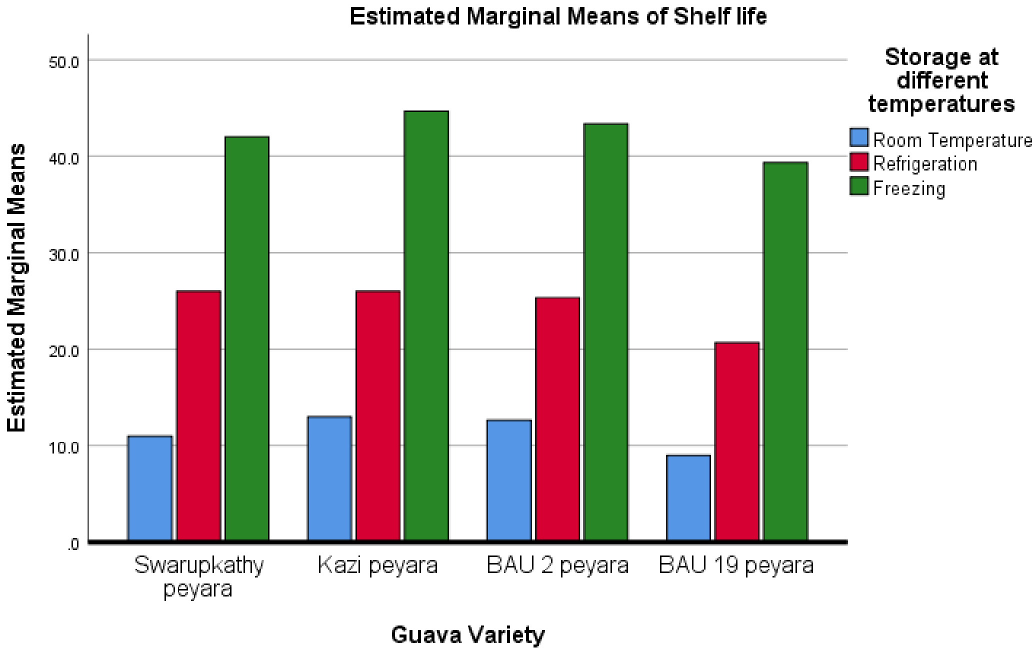

Figure 1. Shelf-life (in days) of different fresh Guava varieties at three different storage conditions

The average score for different sensory parameters of the Guava varieties was within the range given by BSTI (20-25 for color & texture, 40-50 for taste & flavor, 20-25 for absence of defects) and also there was no significant difference ($F(3,24)=0.97$, $p=0.406$) between the varieties (Figure 2).

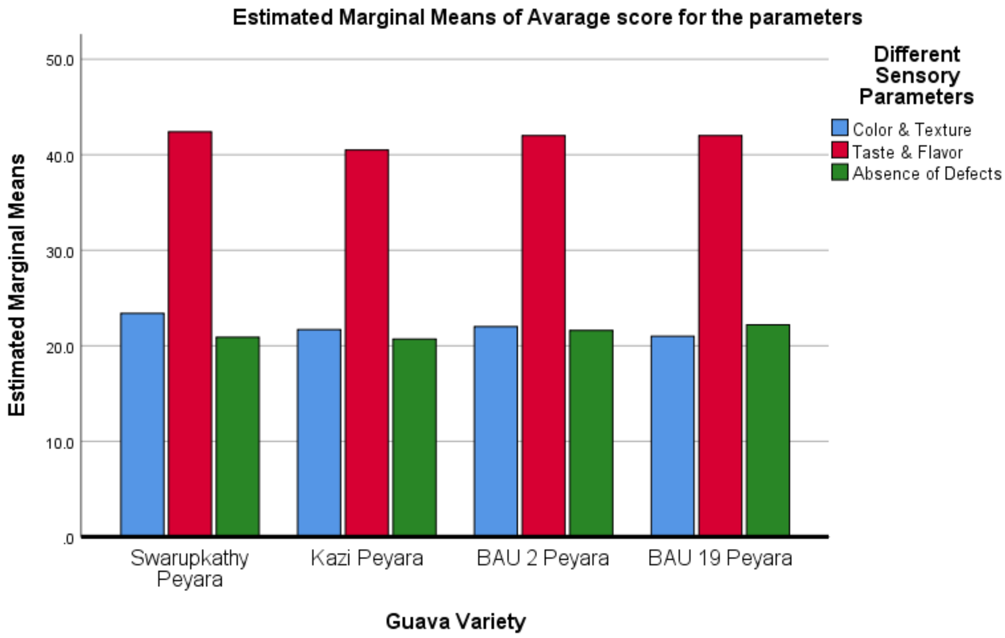

Figure 2. Average scores for color & texture, taste & flavor, and absence of defects for different Guava samples

Table 1. Bio-chemical composition of fresh guava fruit samples

Guava Sample	Moisture (%)	pH	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Ascorbic acid (mg/100 g)	Ca (mg/100 g)	Mg (mg/100 g)	P (mg/100 g)	K (mg/100g)
Swarupkathi Peyara	84.4±0.20^{c}	3.5±0.06^{bc}	4.44±0.03^{c}	5.23±0.03^{c}	9.68±0.06^{d}	193.45±0.45^{b}	14.51±0.46^{b}	16.62±0.51^{c}	30.67±0.46^{c}	385.0±2.75^{b}
Kazi Peyara	86.2±0.25^{b}	3.7±0.06^{ab}	4.77±0.04^{b}	5. 88±0.02^{a}	10.65±0.07^{a}	195.59±0.75^{a}	17.45±0.53^{a}	18±0.55^{b}	34.63±0.94^{a}	374.3±1.4^{c}
BAU-2 Peyara	81.6±0.15^{d}	3.4±0.07^{c}	4.35±0.05^{c}	5.48±0.02^{b}	9.83±0.08^{c}	191.67±0.68^{c}	17.01±0.25^{a}	15.34±0.45^{d}	32.46±0.46^{b}	392.1±2.69^{a}
BAU-19 Peyara	88.9±0.21^{a}	3.9±0.11^{a}	4.90±0.01^{a}	5.21±0.01^{c}	10.11±0.02^{b}	190.37±0.61^{c}	15.42±0.43^{b}	20.15±0.32^{a}	33.61±0.49^{ab}	370.5±1.37^{c}

Data present as mean ±SD, α=0.05, Different letters within a parameter indicate significant differences (Tukey HSD test at p < 0.05)

The chemical components of fresh Guava are more or less parallel to that reported by a previous researcher [14]. They reported that Guava contains 80.8% moisture, 8.92% total sugar, 18 mg/100g Ca, 22 mg/100g Mg, 40 mg/100g P, and 417 mg/100g K. The one-way analysis of variance (ANOVA) were conducted (α= .05) for each individual chemical composition to explore the impact of varieties on the specific composition. The moisture contents (%) of selected Guava varieties were significantly different (df= 3, Mean Square= 28.21, F= 735.83, p<0.001). Results disclosed that the average moisture content was varied from 81.7±0.11 to 89.1±0.21 percent. It was observed that the highest moisture content was found in BAU-19 Peyera and the lowest in BAU-2 Peyera (Table 1). The pH of selected Guava varieties were significantly different (df= 3, Mean Square= 0.079, F= 13.476, p<0.005). Results disclosed that the average pH was varied from 3.4±0.07 to 3.9±0.11. It was observed that the highest pH was found in BAU-19 Peyera and the lowest in BAU-2 Peyera (Table 1). The reducing sugar (%) of selected Guava varieties were significantly different (df= 3, Mean Square= 0.21, F= 163.04, p<0.001). Results revealed that the average reducing sugar was varied from 4.90±0.01 to 4.35±0.05 percent. It was observed that the highest reducing sugar was found in BAU-19 Peyera and the lowest in BAU-2 Peyera (Table 1).

The non-reducing (%) sugar of selected Guava varieties were significantly different (df= 3, Mean Square= 0.28, F= 479.3, p<0.001). Results disclosed that the average non-reducing sugar was varied from 5.88±0.02 to 5.21±0.01 percent. It was observed that the highest non-reducing sugar was found in Kazi Peyera and the lowest in BAU-19 Peyera (Table 1). The total sugar (%) of selected Guava varieties were significantly different (df= 3, Mean Square= 0.55, F= 161, p<0.001). Results revealed that the average total sugar was varied from 10.65±0.07 to 9.68±0.06 percent. It was observed that the highest total sugar was found in Kazi Peyera and the lowest in Swarupkathi Peyera (Table 1). This difference largely depends on genetic factors, [5] completely agree with this result.

According to a group of researchers, Guava juice is a rich source of vitamin C which is the second after Amla [5]. The ascorbic acid (Vitamin-C) of selected Guava varieties were significantly different (df= 3, Mean Square= 15.34, F= 38.32, p<0.001). Results disclosed that the average ascorbic acid was varied from 190.37±0.61 to 195.59±0.75 mg/100g. It was noted that the highest ascorbic acid was found in Kazi Peyera and the lowest in BAU-19 Peyera (Table 1).

Calcium (Ca) content of selected Guava varieties were significantly different (df= 3, Mean Square= 5.67, F= 30.83, p<0.001). Results revealed that the average Ca was varied from 14.51±0.46 to 17.45±0.53 mg/100g. It was observed that the highest Ca was found in Kazi Peyera and the lowest in Swarupkathi Peyera. Magnesium (Mg) content of selected Guava varieties were significantly different (df= 3, Mean Square= 13.16, F= 60.94, p<0.001). Results disclosed that the average Mg was extended from 15.34±0.45 to 20.15±0.32 mg/100g. It was observed that the highest Mg was found in BAU-19 Peyera and the lowest in BAU-2 Peyera. Phosphorus (P) content of selected Guava varieties were significantly different (df= 3, Mean Square= 8.67, F= 22.47, p<0.001). Results indicated that the average S was varied from 30.67±0.46 to 34.63±0.94 mg/100g. It was observed that the highest P was found in Kazi Peyera and the lowest in Swarupkathi Peyera. Potassium (K) content of selected Guava varieties were significantly different (df= 3, Mean Square= 291.63, F= 62.38, p<0.001). Results revealed that the average K was varied from 370.5±1.37 to 392.1±2.69 mg/100g. It was noted that the highest K was found in BAU-2 Peyara and the lowest in BAU-19 Peyera (Table 1).

3.2. Physico-chemical properties of Guava juice

A two-way between-groups analysis of variance (ANOVA) was conducted (α= 0.05) to explore the impact of storage condition and varieties on shelf-life of guava juice in days. Samples are four varieties (S_1, S_2, S_3, S_4) and kept in three different conditions (T_1, T_2, T_3). The interaction effect between varieties and storage condition was statistically significant, $F(6, 24) = 41.9$, $p<0.001$, $\eta^2 = 0.91$. There was a statistically significant difference among the varieties, $F(3, 24) = 12$, $p<0.001$, $\eta^2 = 0.6$ and also differ in storage conditions, $F(2, 24) = 114825$, $p<0.001$, $\eta^2 = 0.99$. Post-hoc comparisons using the Tukey HSD test indicated that the shelf-life of guava juice was significantly different (p<0.001) from each other storage conditions and also the shelf-life was differed among the varieties (the only exception, there is no significant difference between S_1 & S_2 and S_2 & S_3). Figure 3 shows that S_2 had the highest shelf-life in the T_1 & T_2 conditions and S_1 in the T_3 condition.

The prepared guava juice was analyzed for its different chemical components and the results are shown in Table 2.

Table 2. Biochemical constituents of guava juice

Guava Sample Juice	Moisture (%)	TSS (%)	Ascorbic acid (Vitamin C) (mg/100 ml)	Titratable Acidity (%)
Swarupkathi Peyara	96.96±0.56^{a}	0.32±0.01^{bc}	25.49±1.36^{b}	0.67±0.02^{bc}
Kazi Peyara	95.10±0.28^{b}	0.28±0.02^{c}	32.42±4.19^{a}	0.74±0.03^{a}
BAU-2 Peyara	92.78±0.28^{d}	0.35±0.03^{b}	22.19±1.76^{b}	0.61±0.02^{c}
BAU-19 Peyara	94.14±0.20^{c}	0.47±0.01^{a}	26.83±1.01^{ab}	0.80±0.01^{a}

Data present as mean ±SD, α=0.05, Different letters within a parameter indicate significant differences (Tukey HSD test at p < 0.05).

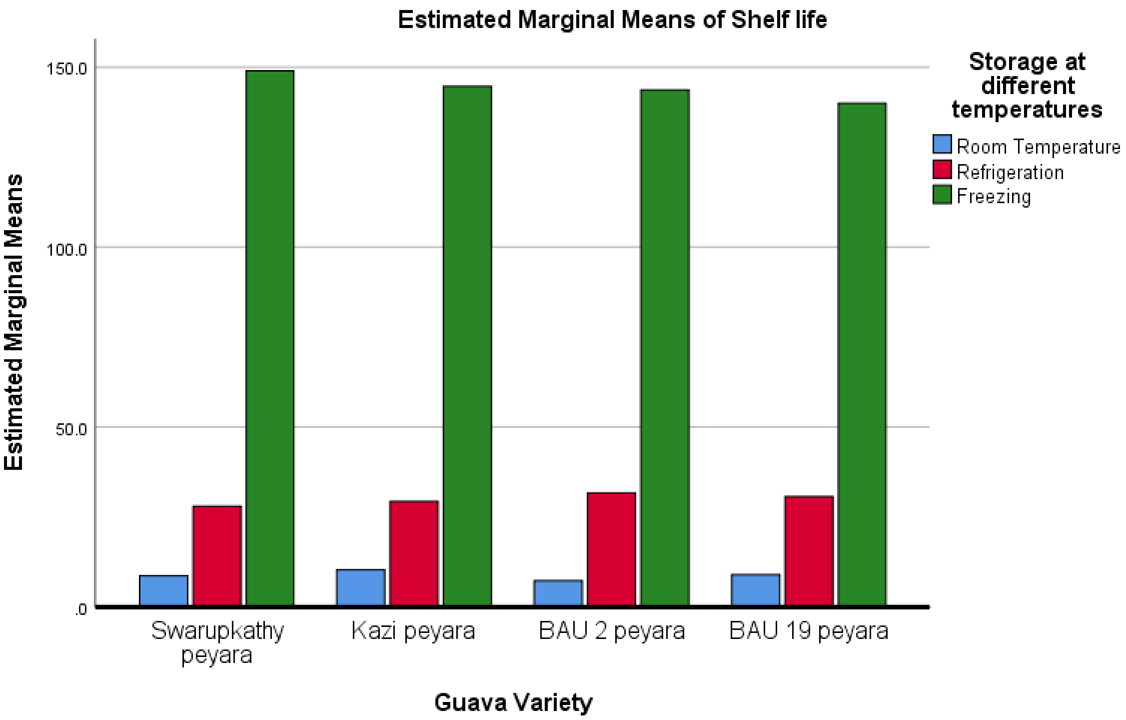

Figure 3. Shelf-Life (in days) of guava juice at different storage conditions

The one-way analysis of variance (ANOVA) was conducted (α= .05) for each individual chemical composition to explore the impact of varieties on the specific composition.

Moisture content (%) of various Guava juice were significantly different (df= 3, Mean Square= 9.24, F= 71.37, p<0.001). Results presented that the average moisture content was varied from 96.96±0.56 to 92.78±0.28 percent. It was noted that the highest moisture content was found in Swarupkathi Peyera Juice and the lowest in BAU-2 Peyera Juice (Table 2). TSS (%) of various Guava juice were significantly different (df= 3, Mean Square= 0.021, F= 62.58, p<0.001). Results disclosed that the average TSS was extended from 0.47±0.01 to 0.28±0.02 percent. A study reported no change in total sugar content of the RTS beverage of red fleshed guava [20]. It was noted that the highest moisture content was found in BAU-19 Peyera Juice and the lowest in Kazi Peyera Juice (Table 2). Vitamin C content of various Guava juice were significantly different (df= 3, Mean Square= 54.5, F= 9.23, p<0.01). Results revealed that the average Vitamin C was extended from 22.19±1.76 to 32.42±4.19 mg/100ml. It was observed that the highest Ascorbic acid was found in Kazi Peyera Juice and the lowest in BAU-2 Peyera Juice (Table 2). It was also noticeable that the Vitamin C content was lower in juice than fresh guava. The ascorbic acid content of juice decreases with the increase of heating time [21]. Titratable Acidity (%) of various Guava juice were significantly different (df= 3, Mean Square= 0.021, F= 34.6, p<0.001). Results presented that the average titratable acidity was varied from 0.80±0.01 to 0.61±0.02 percent. It was observed that the highest titratable acidity was found in BAU-19 Peyera Juice and the lowest in BAU-2 Peyera Juice (Table 2).

3.3. Physico-chemical properties of Guava jelly

A two-way between-groups analysis of variance (ANOVA) was conducted (α= .05) to explore the impact of storage conditions and varieties on the shelf-life of guava jelly. Samples are four varieties (S_1, S_2, S_3, S_4) and kept in three different conditions (T_1, T_2, T_3). The interaction effect between varieties and storage condition was statistically significant, $F(6, 24) = 20.5$, $p<0.001$, $\eta^2 = 0.84$. There was a statistically significant difference among the varieties, $F(3, 24) = 147.9$, $p<0.001$, $\eta^2 = 0.95$ and also differ in storage conditions, $F(2, 24) = 18132$, $p<0.001$, $\eta^2 = 0.99$. Post-hoc comparisons using the Tukey HSD test indicated that the shelf-life of guava jelly was significantly different (p<0.001) from each other storage conditions and also the shelf-life was differed among the varieties (the only exception, there was no significant difference between S_1 & S_4). Figure 4 shows that S_2 had the highest shelf-life in the T_1, S4 in the T_2 and S_2 in the T_3 condition. Generally, high sugar content creates the moisture inaccessible for the growth of microorganisms, consequently improve the shelf life of food [15]. A researcher conducted a storage study on the jellies for nine months at room temperature (23-30°C) and relative humidity 80 to 85%. It was observed that TSS, pH and acidity of jelly did not show any remarkable changes [11]. Colour and flavour was acceptable up to 210 days but after 210 days the colour and flavour of jellies were changed due to fungal growth and incipient spoilage.

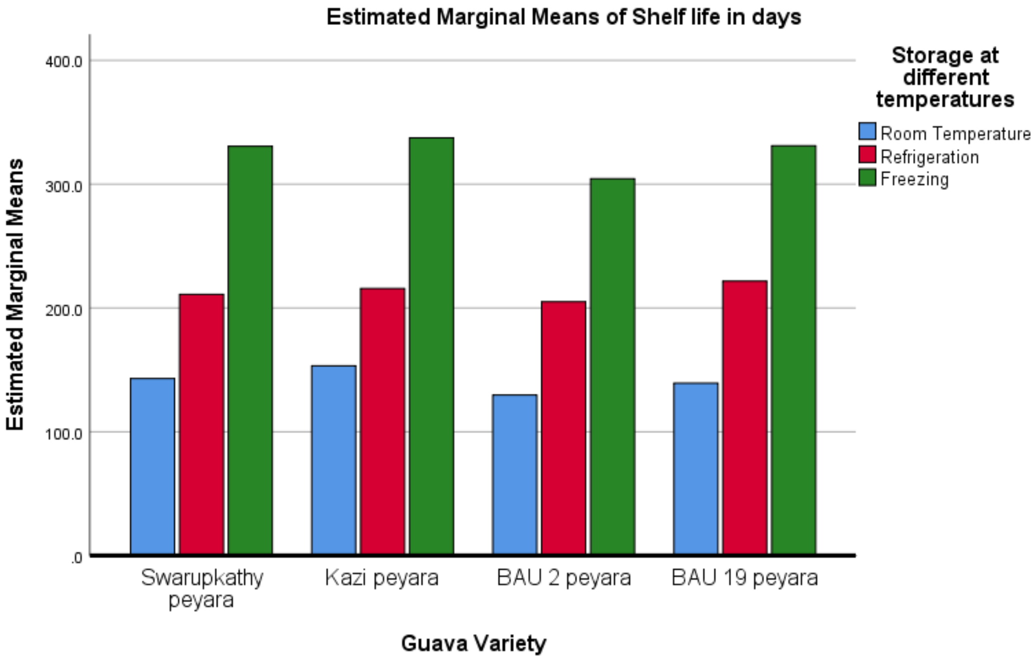

Figure 4. Shelf-life (in days) of guava jelly at different storage conditions

3.4. Sensory Quality

The average scores for different sensory parameters of the Guava Jelly were within the range given by BSTI (20-25 for color & texture, 40-50 for taste & flavor, 20-25 for absence of defects) and also there was no significant difference ($F(3,24)=0.77$, $p=0.51$) between the varieties (Figure 5). The sensory score increased when jelly bar was packed in an aluminum foil and refrigerated condition rather than normal condition [16]. A study reported similar results while working on guava fruit bar [17]. A group of researchers studied the effect of storage temperature and sensory quality of guava nectar and found that nectar stored in ambient temperature were better accepted [18].

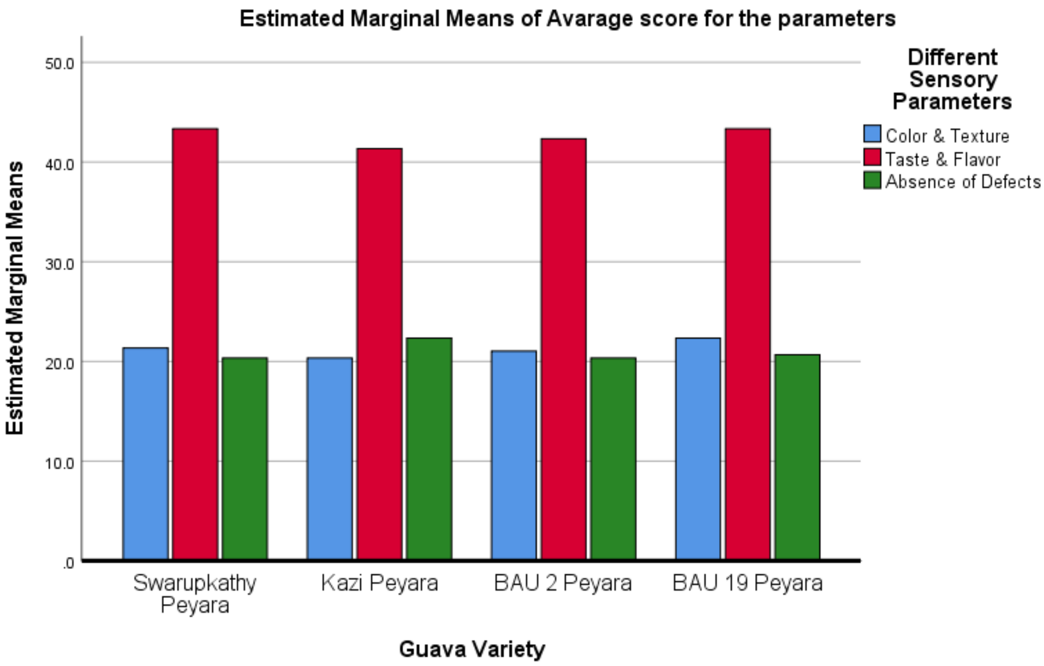

Figure 5. Average score for color & texture, taste & flavor, and absence of defects for various Guava jelly samples

The prepared guava jelly was analyzed for its different chemical components and the results are shown in Table 3.

Table 3. Biochemical constituents of guava jelly

Guava Sample Juice	Moisture (%)	TSS (%)	Ascorbic acid (Vitamin C) (mg/100 g)	pH	Ca (mg/100 g)	Mg (mg/100 g)	P (mg/100 g)	K (mg/100g)
Swarupkathi Peyara	15.3±0.24[a]	64.2±0.36[b]	16.41±0.44[b]	4.5±0.06[b]	12.48±1.52[c]	16.13±0.89[b]	24.61±1.69[b]	325.9±3.54[ab]
Kazi Peyara	12.9±0.12[c]	67.56±0.44[a]	17.11±0.23[b]	4.7±0.05[b]	16.51±0.54[a]	18.46±0.53[a]	30.19±1.25[a]	317.4±3.99[bc]
BAU-2 Peyara	14.7±0.26[b]	60.1±0.18[d]	18.99±0.21[a]	5.0±0.06[a]	15.11±0.64[ab]	12.84±0.88[c]	25.64±0.82[b]	335.3±4.02[a]
BAU-19 Peyara	14.3±0.12[b]	63.1±0.51[c]	18.11±0.45[a]	4.7±1.0[b]	12.67±0.46[c]	19.37±0.61[a]	27.62±0.79[ab]	314.8±3.70[c]

Data present as mean ±SD, α=0.05, Different letters within a parameter indicate significant differences (Tukey HSD test at p < 0.05)

The one-way analysis of variance (ANOVA) was conducted (α=0.05) for each individual chemical composition to explore the impact of varieties on the specific composition.

Moisture content (%) of various Guava jelly were significantly different (df= 3, Mean Square= 3.17, F= 80.67, p<0.001). Results presented that the average moisture content was varied from 12.9±0.12 to 15.3±0.24 percent. It was seen that the highest moisture content was found in Swarupkathi Peyera Jelly and the lowest in Kazi Peyera Jelly (Table 3). TSS (%) of various Guava jelly were significantly different (df= 3, Mean Square= 29.1, F= 186.1, p<0.001). Results displayed that the average TSS was varied from 60.1±0.18 to 67.56±0.44 percent. It was noted that the highest moisture content was found in Kazi Peyera Jelly and the lowest in BAU-2 Peyera Jelly (Table 3). Vitamin C content of various Guava jelly were significantly different (df= 3, Mean Square= 3.86, F= 31.74, p<0.001). Results exhibited that the average Vitamin C was varied from 16.41±0.44 to 18.99±0.21 mg/100ml. It was noted that the highest Ascorbic acid was found in BAU-2 Peyera Jelly and the lowest in Swarupkathi Peyera Jelly (Table 3). pH of various Guava Jelly were significantly different (df= 3, Mean Square= 0.13, F= 26, p<0.001). Results disclosed that the average pH was varied from 4.5±0.06 to 5.0±0.06. It was observed that the highest pH was found in BAU-2 Peyera Jelly and the lowest in Swarupkathi Peyera Jelly (Table 4.3). Desrosier et al. (1978) stated that gel formation happens only within a narrow range of pH (near 4.2) values.

Calcium (Ca) content of various Guava Jelly were significantly different (df= 3, Mean Square= 11.46, F= 14.25, p<0.01). Results presented that the average Ca was varied from 12.48±1.52 to 16.51±0.54 mg/100gm. It was observed that the highest Ca was found in Kazi Peyera Jelly and the lowest in Swarupkathi Peyera Jelly. Magnesium (Mg) content of various Guava Jelly were significantly different (df= 3, Mean Square= 25.42, F= 45.5, p<0.001). Results disclosed that the average Mg was varied from 12.84±0.88 to 19.37±0.61 mg/100gm. It was noted that the highest Mg was found in BAU-19 Peyera Jelly and the lowest in BAU-2 Peyera Jelly.

Phosphorus (P) content of various Guava Jelly were significantly different (df= 3, Mean Square= 18.11, F= 12.64, p<0.01). Results displayed that the average P was varied from 24.61±1.69 to 30.19±1.25 mg/100g. It was noted that the highest P was found in Kazi Peyera Jelly and the lowest in Swarupkathi Peyera Jelly. It was also noticeable that the mineral content was lower in Jelly than fresh guava. Potassium (K) content of various Guava Jelly were significantly different (df= 3, Mean Square= 256.9, F= 17.6, p<0.01). Results presented that the average K was varied from 314.8±3.70 to 335.3±4.02 mg/100g. It was noted that the highest K was found in BAU-2 Peyara Jelly and the lowest in BAU-19 Peyera Jelly (Table 3). It was also noticeable that the mineral content was lower in Jelly than fresh guava.

3.5. Deterioration of Vitamin C during storage

A one-way repeated measure ANOVA was conducted to compare Vitamin C content (mg/100g) in different Guave Jelly at zero days (at Jelly preparation day), 30 days (after storing 30 days), 60 days (after storing 60 days), and 90 days (after storing 90 days). There was a significant difference in Vitamin C content in Guava Jelly at different storage times (Vitamin C decreased significantly), F (3,8) = 211.2, p < .001, partial eta squared = 0.95 (Figure 6). A researcher found that physico-chemical characteristics like total sugars and TSS increased while acidity, pectin content, ascorbic acid, and organoleptic scores decreased in the jelly bar stored in ambient condition while the changes are negligible for the jelly bar in refrigerated storage [16]. Jelly bar packed in laminated aluminium foil and stored in refrigerated condition has better quality till consumption.

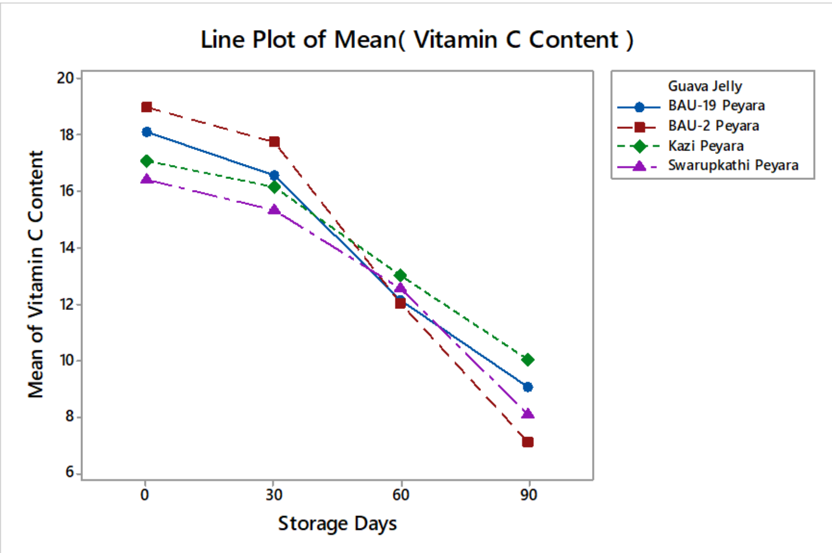

Figure 6. Changes of Ascorbic acid (Vitamin-C) during storage of guava jelly.

3.6. Comparative study of Vitamin C content

A one-way ANOVA was conducted to compare Vitamin C content (mg/100g) in different processing stages of Guava. There was a significant difference in Vitamin C content at different stages of processing, $F(2,9) = 1315$, $p < .001$, partial eta squared = 0.96 (Figure 7).

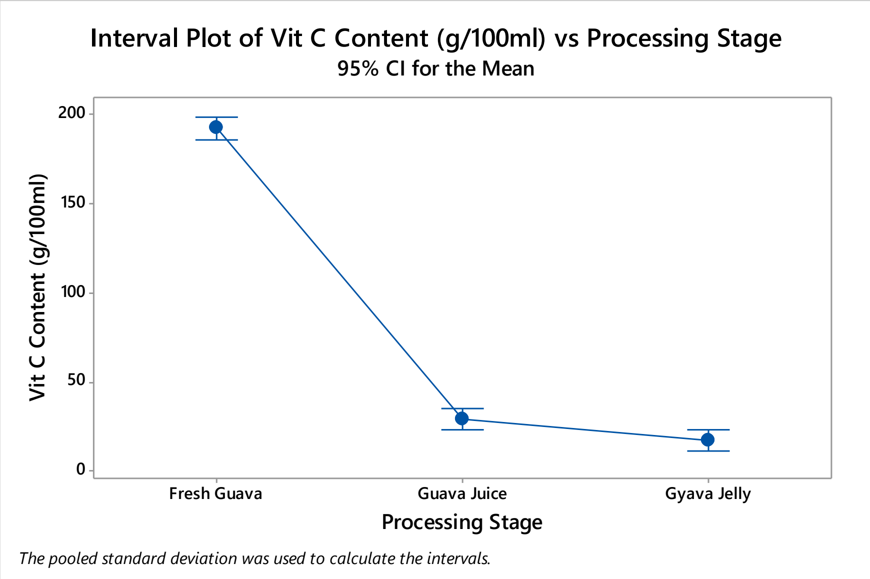

Figure 7. Changes of Vitamin-C content in different processing stages

4.0. Conclusions

This study indicates that Guava is a decent source of Vitamin C and Minerals and also has an upright shelf-life and acceptability. Guava Juice also contains obvious nutrients but the loss of Vitamin C is noticeable. The shelf-life of Guava Juice in freezing conditions gives enough time for further processing. The prepared Guava Jelly had a good appearance, nutritive value, and also an evident shelf-life. The increased processing of Guava will help to mitigate a huge post-harvest loss; farmers will be economically benefited and consumers will get nutritive Guava Jelly. Further research is needed for establishing a large-scale Guava Jelly processing sector in Bangladesh.

5.0. Conflict of Interest

The authors declare no conflict of interest.

6.0. Acknowledgement

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7.0. REFERENCES

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