

Research Article

Organoleptic and Nutritional Evaluation of Value Added Products Developed from New Varieties of White and Pink-Fleshed Guavas

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Abstract

Guava is a fruit crop widely grown in India and is consumed for its great taste and nutritional benefits. The present study was conducted to develop three value added products namely jam, jelly and RTS beverage from different varieties of white and pink fleshed guavas and evaluate their sensory and nutritional characteristics. Kruskal Wallis test and one-way analysis of variance (ANOVA) were applied respectively to find the significant difference in sensory and nutritional parameters of the products developed from different varieties. On the basis of sensory evaluation it was found that the pink-fleshed guava varieties had greater preference for the value added products. Among different variations, jam and jelly developed from Punjab Pink and RTS beverage made from Lalit variety had higher overall acceptability scores. The products developed from each variety were then analysed for proximate composition, minerals like calcium, phosphorus and potassium, vitamin C and total carotenoid content.

Jam followed by RTS beverage and jelly was found to have a good nutrient profile. Therefore, the new varieties of guava have a vast scope for utilization into commercial products that can be exploited for their great taste and nutritional benefits.

Keywords: Guava varieties, nutritional composition, sensory evaluation, value added products

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Introduction

Guava (*Psidium guajava* L.) which belongs to the family *Myrtaceae*, is one of the most widely grown fruit crop of tropical and subtropical regions of the world. Guava is extensively cultivated in India over 246.2 thousand hectare land with a production of 3993.5 thousand million tones [1]. The tree being hard and prolific bearer, requires less water, can be grown on variety of soil and is not affected by adverse climatic conditions. Guava tree bears fruit twice in a year i.e. during summer and winter but the best quality fruit is obtained in the winter season [2]. The skin of the fruit and flesh colour varies between cultivars depending on the type and amount of pigments present. The fruit has a sweet taste, special characteristic odour and a little astringency. Due to their astringent properties, mature guava fruits, leaves, roots, bark and immature fruits are used in local medicine to treat gastroenteritis, diarrhea and dysentery [3]. The fruits are known to possess large amounts of vitamins and minerals particularly vitamin C and potassium together with high levels of polyphenolic antioxidants particularly quercetin [4]. Guava fruits also have immense bioactive potential and are a good source of dietary fiber which functions as prebiotics. Having such good nutrient profile makes guava exhibit potent anti-inflammatory, antihypertensive, antioxidant and hypoglycemic activities.

Guava is normally consumed fresh as a desert fruit. However, due to its highly perishable nature, the post harvest management of the fruits with special reference to value addition becomes important. It is, therefore, imperative to develop preserved products from guava to utilize the surplus produce and making it available for longer period. Thus keeping in mind all these perspectives, the present study aimed to develop three sugar based value added products i.e. jam, jelly and RTS from newly developed varieties of white and pink-fleshed guavas and to evaluate their organoleptic and nutritional quality.

Materials and Methods

The study was conducted at the department of Food and Nutrition, Punjab Agricultural University, Ludhiana. Six varieties of guava - Sardar, Shweta and Hisar Safeda that were white-fleshed and Lalit, Punjab Pink and Hisar Surkha that were pink-fleshed were procured from Regional Fruit Research Station, Patiala, Punjab. Three value added products i.e. jam, jelly and RTS were developed from each guava variety. Fully ripe and mature guava fruits were used for the preparation of jam and RTS beverage. For guava jelly, slightly under ripe fruits along with few fully ripe

fruits were used due to high pectin content in under ripe guavas. Other ingredients such as sugar and citric acid were purchased from local market for the development of products.

Development of guava jam

The Guavas after washing were cut to remove seed core and then grated. The grated material was cooked for 5-10 minutes and passed through the fruit strainer to get uniform pulp. Sugar (375 g), citric acid (1.25 g) and water (375 ml) was added to the pulp (500 g) and it was further cooked with continuous stirring to raise the concentration to 68 °Brix. The prepared jam was hot filled in pre-sterilized glass bottles and after capping stored airtight.

Development of guava jelly

Slightly under ripe and few fully ripe guava fruits (500 g) were thoroughly washed and cut into round shape. Water (625 ml) and half the citric acid (1.25 g) was added to the guava slices and it was boiled for 30 minutes. While boiling, fruit pieces were pressed with ladle for the extraction of juice and pectin. It is then strained through muslin cloth to get the clear extract. Sugar (500 g) and remaining citric acid (1.25 g) was added to the extract and cooked to a concentration of 68 °Brix without stirring. Jelly was poured hot into clean and dry glass jars and tightly capped.

Development of guava RTS beverage

Fully mature fruits were cut into pieces, crushed and mixed with equal amount of water. The mixture was then passed through pulper to obtain pulp. Sugar syrup was prepared by adding sugar (120 g) and citric acid (3 g) to water and heating it just to boil the contents. Sugar syrup was strained and pulp (120 g) was added to it. The beverage was homogenized and then filled into autoclaved glass bottles leaving a head space of 2.5 to 3.0 cm, and then screw capped. After corking the bottles were pasteurized at about 85°C for 5 minutes.

Sensory analysis of the developed products

Sensory evaluation of the products – jam, jelly and RTS beverages developed from different varieties of white and pink-fleshed guava was carried out by a panel of ten semi-trained judges. The panelists evaluated the products for sensory attributes i.e. colour, taste, aroma, texture, flavour and overall acceptability on a 9-point hedonic scale as described by Larmond 1970 [5] to determine the most acceptable variety for each product. All the products were then analysed for their nutrient content.

Nutritional evaluation of the products

Proximate composition of the guava products i.e. moisture, crude protein, crude fat, crude fiber, total ash and carbohydrates (by difference) were determined by the standard procedures of AOAC [6]. Minerals – calcium, phosphorus and potassium were estimated using atomic absorption spectrophotometer (AAS, Varian model) after wet digestion method given by Piper [7]. Samples were analysed for ascorbic acid content using 2,6-dichlorophenol indophenol dye colourimetrically as per the procedure of AOVC [8]. Total carotenoids in the products were determined using petroleum ether as extracting solvents and estimating the extract in UV/visible spectrophotometer at 450 nm as described by Zakaria *et al.* [9].

Results and Discussion

Sensory evaluation of the guava products

The sensory scores for products developed from white and pink fleshed guava varieties are presented in **Table 1(a-c)**. For the jam made from different guava cultivars, it is apparent that the scores differ significantly ($p \leq 0.05$) with regard to all sensory parameters (Table 1a). Overall acceptability scores were highest for jam developed from Shweta (7.35) whereas for pink variety it was highest for Punjab Pink (7.65). For the guava jellies, the differences in sensory scores were found to be statistically significant for texture, flavor and overall acceptability (Table 1b). Jelly made from Sardar scored highest (7.64) among white varieties and for pink varieties Punjab Pink jelly (7.71) had highest acceptability scores. For the RTS developed from different varieties, the sensory scores were statistically significant ($p \leq 0.05$) for the all the other parameters i.e. appearance, colour, flavor and overall acceptability, except for consistency (Table 1c). Among white-fleshed varieties, RTS beverage developed from Sardar had highest overall acceptability (7.36) whereas for pink guava varieties it was highest for Lalit (7.55).

Table 1a Mean sensory scores for jam prepared from white and pink-fleshed varieties of guava

	Varieties							
	White fleshed				Pink fleshed			
	Sardar	Shweta	Hisar Safeda	χ^2	Lalit	Punjab Pink	Hisar Surkha	χ^2
Appearance	6.50	7.50	7.15	6.92*	6.90	7.70	6.60	9.94*
Colour	6.40	7.30	7.15	6.57*	6.70	7.70	6.50	10.34*
Texture	6.35	7.25	6.48	6.52*	6.60	7.60	6.50	10.81*
Flavour	6.65	7.35	6.70	6.16*	6.50	7.60	6.60	10.66*
Overall acceptability	6.48	7.35	6.86	8.95*	6.68	7.65	6.55	15.86*

*Significant at 5% level of significance ($p \leq 0.05$)**Table 1b** Mean sensory scores for jelly prepared from white and pink-fleshed varieties of guava

	Varieties							
	White-fleshed				Pink-fleshed			
	Sardar	Shweta	Hisar Safeda	χ^2	Lalit	Punjab Pink	Hisar Surkha	χ^2
Appearance	7.60	6.95	7.05	5.36 ^{NS}	6.90	7.80	6.80	9.99*
Colour	7.50	6.90	6.80	4.72 ^{NS}	7.00	7.80	7.10	6.09*
Texture	7.75	7.10	7.20	6.09*	7.20	7.70	7.30	3.66 ^{NS}
Flavor	7.70	7.10	6.95	8.58*	7.25	7.55	7.20	1.78 ^{NS}
Overall acceptability	7.64	7.01	7.00	10.89*	7.09	7.71	7.10	9.26*

*Significant at 5% level of significance ($p \leq 0.05$); NS – Not significant**Table 1c** Mean sensory scores for RTS beverage prepared from white and pink-fleshed varieties of guava

	Varieties							
	White fleshed				Pink fleshed			
	Sardar	Shweta	HisarSafeda	χ^2	Lalit	Punjab Pink	HisarSurkha	χ^2
Appearance	7.60	6.50	6.60	8.14*	7.70	7.00	6.85	6.59*
Colour	7.70	6.30	6.80	12.05*	7.80	6.60	6.80	13.74*
Texture	6.75	7.50	6.55	5.26 ^{NS}	7.20	7.20	6.65	2.70 ^{NS}
Flavour	7.40	6.45	6.40	7.01*	7.50	6.40	6.60	12.13*
Overall acceptability	7.36	6.69	6.59	6.45*	7.55	6.80	6.73	10.06*

*Significant at 5% level of significance ($p \leq 0.05$); NS – Not significant

Overall, pink fleshed guava varieties were preferred for the guava products in comparison to the white fleshed varieties. For jam and jelly Punjab Pink variety of pink-fleshed guava had highest overall acceptability while for RTS beverage Lalit variety was found to be most acceptable. Products from other varieties were also liked at various degrees although to a lesser extent than the above mentioned varieties.

Nutritional analysis of guava products

The nutritional evaluation of the guava products was conducted and the results were as presented in **Table 2(a-c)**. Data shown in the tables indicated that the concentration of all the nutrients were highest in guava jam compared with those of other guava products. However, the moisture content was highest and carbohydrates were lowest for the guava RTS beverages.

Guava Jam

The jams developed from different varieties of guava were found to be significantly different ($p \leq 0.05$) for all the nutrients except for fat (Table 2a). Protein content was found to be highest (0.29%) in jam made from Lalit variety whereas, highest vitamin C (19.63 mg/100g) and calcium content (4.89 mg/100g) were observed for the jam developed from Sardar variety. Jam from Punjab pink variety had lowest moisture (26.89%), and maximum fiber (2.16%), ash (0.32%), phosphorus (8.81 mg/100g), potassium (42.62 mg/100g) and total carotenoids (3.17 mg/100 g) while carbohydrate content was maximum (70.98%) in Hisar Safeda jam. High carbohydrate content may be attributed to the addition of large amount of sugar while preparing jam. Similar results were reported by Tanwar *et al.* [10] for guava jam having moisture 19.9 %, crude fat 0.09 %, crude fiber 1.8 % and ash 0.3 % but the crude fiber

content was 2.8 % which was much higher than the values obtained in present study. Ajenifujah-Solebo and Aina [11] observed 68.1 % carbohydrate, 0.97 mg/100g calcium and 1.42 mg/100g potassium in black-plum jam.

Table 2a Nutritional composition of jam developed from different varieties of guava

	Varieties					
	White fleshed			Pink fleshed		
	Sardar	Shweta	Hisar Safeda	Lalit	Punjab Pink	Hisar Surkha
Moisture, %	33.87 ^a ±0.22	31.26 ^{ab} ±0.51	27.05 ^c ±0.58	30.76 ^{ab} ±0.33	26.89 ^{abc} ±0.36	28.57 ^d ±1.31
Crude Protein, %	0.19 ^b ±0.01	0.22 ^{ab} ±0.02	0.28 ^a ±0.01	0.29 ^a ±0.03	0.26 ^{ab} ±0.01	0.21 ^{ab} ±0.02
Crude Fat, %	0.04±0.02	0.03±0.01	0.03±0.01	0.04±0.03	0.02±0.01	0.03±0.01
Crude Fiber, %	1.89 ^{ab} ±0.05	1.60 ^b ±0.11	1.46 ^{bc} ±0.07	0.92 ^c ±0.18	2.16 ^a ±0.16	1.38 ^{bc} ±0.04
Ash, %	0.24 ^{abc} ±0.03	0.17 ^c ±0.01	0.19 ^{bc} ±0.02	0.29 ^{ab} ±0.03	0.32 ^a ±0.02	0.23 ^{abc} ±0.02
Carbohydrates, %	63.75 ^d ±0.27	66.69 ^{cd} ±0.45	70.98 ^a ±0.65	67.69 ^{bc} ±0.48	70.32 ^{ab} ±0.33	69.57 ^{abc} ±1.29
Calcium, mg/100 g	4.89 ^a ±0.10	4.77 ^a ±0.07	4.19 ^{ab} ±0.15	4.46 ^{ab} ±0.24	3.98 ^b ±0.21	4.25 ^{ab} ±0.04
Phosphorus, mg/100 g	7.33 ^c ±0.08	7.77 ^{bc} ±0.13	8.11 ^{ab} ±0.24	7.91 ^{bc} ±0.26	8.81 ^a ±0.06	8.45 ^{ab} ±0.03
Potassium, mg/100 g	37.84 ^{ab} ±1.48	32.69 ^{bc} ±0.81	28.33 ^c ±0.09	35.91 ^b ±1.99	42.62 ^a ±0.57	34.03 ^b ±0.33
Vitamin C, mg/100 g	19.63 ^a ±0.33	13.72 ^d ±0.18	16.66 ^{bc} ±0.67	18.79 ^{ab} ±0.85	16.19 ^c ±0.12	11.59 ^d ±0.11
Total carotenoids, mg/100 g	-	-	-	2.61 ^{ab} ±0.19	3.17 ^a ±0.16	1.80 ^b ±0.20

Values are given as Mean ± SE
 Figures with different superscripts are significantly different (p≤0.05)

Table 2b Nutritional composition of jelly developed from different varieties of guava

	Varieties					
	White-fleshed			Pink-fleshed		
	Sardar	Shweta	Hisar Safeda	Lalit	Punjab Pink	Hisar Surkha
Moisture, %	38.50 ^a ±0.94	33.80 ^b ±0.63	33.68 ^b ±0.14	36.67 ^{ab} ±0.25	38.63 ^a ±1.20	35.59 ^{ab} ±0.40
Crude Protein, %	0.02±0.01	0.03±0.01	0.04±0.01	0.04±0.02	0.03±0.01	0.03±0.02
Crude Fat, %	-	-	-	-	-	-
Crude Fiber, %	-	-	-	-	-	-
Ash, %	0.13 ^{ab} ±0.02	0.08 ^b ±0.02	0.10 ^{ab} ±0.01	0.17 ^a ±0.03	0.19 ^a ±0.01	0.14 ^{ab} ±0.01
Carbohydrates, %	61.34 ^b ±0.98	66.08 ^a ±0.62	66.18 ^a ±0.12	63.11 ^{ab} ±0.23	61.14 ^a ±1.20	64.23 ^{ab} ±0.43
Calcium, mg/100 g	2.23 ^{ab} ±0.09	2.46 ^a ±0.06	2.19 ^{ab} ±0.12	1.93 ^{ab} ±0.24	1.56 ^b ±0.15	1.83 ^{ab} ±0.17
Phosphorus, mg/100 g	2.81 ^{cd} ±0.06	3.30 ^{abc} ±0.24	3.63 ^{ab} ±0.03	2.51 ^d ±0.09	3.94 ^a ±0.19	2.97 ^{bc} ±0.17
Potassium, mg/100 g	17.30 ^b ±0.17	11.57 ^c ±0.13	9.16 ^d ±0.38	13.65 ^{cd} ±1.21	20.55 ^a ±0.14	16.28 ^b ±0.08
Vitamin C, mg/100 g	11.19 ^a ±0.21	7.47 ^b ±0.08	10.87 ^a ±0.05	11.77 ^a ±1.24	9.72 ^{ab} ±0.16	7.22 ^b ±0.24
Total carotenoids, mg/100 g	-	-	-	1.53±0.17	1.80±0.20	1.26±0.24

Values are given as Mean ± SE
 Figures with different superscripts are significantly different (p≤0.05)

Guava Jelly

A significant difference (p≤0.05) in the nutritional composition was observed in the jellies with respect to the cultivars except for protein (Table 2b). Crude fat and crude fiber were found to be negligible in all the jellies which may be because of using only clear extract of guava fruit which is devoid of fiber; and very low fat content of 0.2–0.3 % in guava fruit as reported by Gopalan *et al.* [12]. The moisture was minimum (33.68%) whereas carbohydrate content was maximum (66.18%) in jelly developed from Hisar Safeda. Highest vitamin C content (11.77%) was recorded in jelly made from Lalit while calcium content (2.46%) was highest in jelly made from Shweta variety. Jelly from Punjab Pink variety was found to have maximum of ash (0.19%), phosphorus (3.94 mg/100g), potassium (20.55 mg/100g) and total carotenoid content (1.80 mg/100g).

Guava RTS beverage

The proximate composition, minerals, ascorbic acid and total carotenoid content were significantly different (p≤0.05) for the RTS developed from six different varieties of white and pink-fleshed guavas except for protein (Table 2c). The protein content in the beverages ranged from 0.06 – 0.09 %. Ranote *et al.* [13] reported 0.40 % protein in fresh kinnow juice. The moisture content which ranged from 82.23 – 87.39 % was highest in the RTS as only 12% pulp

from fresh fruit was incorporated in the development of RTS which was then diluted with water. The RTS beverage developed from Shweta variety of guava had a minimum moisture (82.23%) and maximum carbohydrate content (17.01%) while beverage from Sardar variety had highest calcium (2.27 mg/100g) and vitamin C (13.87 mg/100g). Ranote *et al.* [13] found 22.4 mg/100 ml ascorbic acid in fresh kinnow juice while only 3 mg/100 ml in processed RTS from kinnow. Kadam *et al.* [14] reported that ascorbic acid content decreases with increase in dilution and was 7.56 mg/100 g in pink-fleshed guava beverage. Among all the RTS beverages, highest values for ash content (0.27%), crude fiber (0.61%), phosphorus (4.26 mg/100g), potassium (13.46 mg/100g) and total carotenoids (1.68 mg/100g) were recorded for the beverage made from Punjab Pink variety. Dhaliwal and Hira [15] reported that fresh carrot: beetroot (95:5) had 3.56 mg/100 g of β -carotene which decreases to 2.88 mg/100 g after pasteurization, thus accounting for 19.10 % reduction.

Table 2c Nutritional composition of RTS beverage developed from different varieties of guava

	Varieties					
	White fleshed			Pink fleshed		
	Sardar	Shweta	HisarSafeda	Lalit	Punjab Pink	HisarSurkha
Moisture, %	84.28 ^{ab} ±0.88	82.23 ^b ±0.30	85.04 ^{ab} ±0.59	87.39 ^a ±0.16	85.52 ^b ±0.17	86.53 ^a ±1.17
Crude Protein, %	0.06±0.01	0.07±0.01	0.08±0.01	0.09±0.02	0.06±0.02	0.06±0.02
Crude Fiber, %	0.57 ^{ab} ±0.02	0.53 ^{abc} ±0.03	0.43 ^{bc} ±0.06	0.38 ^c ±0.03	0.61 ^a ±0.02	0.49 ^{abc} ±0.01
Ash, %	0.18 ^c ±0.02	0.15 ^c ±0.02	0.19 ^{bc} ±0.01	0.25 ^{ab} ±0.01	0.27 ^a ±0.02	0.21 ^{abc} ±0.01
Carbohydrates, %	14.89 ^{ab} ±0.88	17.01 ^a ±0.29	14.25 ^{ab} ±0.66	11.89 ^b ±0.14	13.52 ^b ±0.18	12.71 ^b ±1.18
Calcium, mg/100 g	2.27 ^a ±0.05	1.98 ^{ab} ±0.24	2.19 ^a ±0.03	1.81 ^{ab} ±0.10	1.49 ^b ±0.14	1.66 ^{ab} ±0.06
Phosphorus, mg/100 g	3.55 ^{bc} ±0.12	3.33 ^c ±0.03	3.85 ^{abc} ±0.19	3.63 ^{abc} ±0.06	4.26 ^a ±0.24	4.14 ^{ab} ±0.11
Potassium, mg/100 g	11.17 ^{ab} ±0.15	7.27 ^{bc} ±0.10	6.85 ^c ±1.24	9.87 ^{abc} ±0.05	13.46 ^a ±1.56	9.19 ^{bc} ±0.26
Vitamin C, mg/100 g	13.87 ^a ±0.30	8.28 ^d ±0.64	11.85 ^{ab} ±0.05	12.24 ^{ab} ±0.13	10.45 ^{bc} ±0.76	8.85 ^{cd} ±0.28
Total carotenoids, mg/100 g	-	-	-	1.44±0.32	1.68±0.28	0.97±0.06

Values are given as Mean ± SE
 Figures with different superscripts are significantly different ($p \leq 0.05$)

Conclusion

Guavas have a vast scope for diversification and utilization into commercial products that can be exploited for their great taste and nutritional benefits. The results from the present study indicates that the new varieties of guava are suitable for preparing various value added products such as jam, jelly, RTS beverages etc. Guava jam and jelly finds application in bread sandwiches and other snack items whereas RTS beverage from guava can be used as a substitute for carbonated drinks. Besides having good nutritional and sensory qualities, these products are also useful in meeting the consumer's demand for dietary diversification and to increase the availability of fruit over an extended period of time.

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