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Organoleptic characteristics and nutritive value of candy developed from new varieties of guava

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Abstract
The present investigation was carried out with the objective to prepare candy from six newly developed varieties of white and pink fleshed guavas and to determine their sensory and nutritional quality. Mean overall acceptability scores were significantly different ($p \leq 0.05$) for the guava candies developed from different varieties. On the basis of organoleptic evaluation, Punjab Pink (pink-fleshed) and Hisar Safeda (white-fleshed) candy were found to have higher acceptability. Candies from each variety were then analysed for their proximate composition, minerals such as potassium, calcium, phosphorus and vitamin C and total carotenoid content. The nutritional analysis showed a significant difference ($p \leq 0.05$) among candies with regard to the varieties. Candy made from Punjab Pink was found to have minimum moisture (6.90%) and maximum amount of fiber (5.21%), total ash (0.57%), phosphorus (16.70 mg/100g) and total carotenoids (4.90 mg/100g). Protein content was highest (0.42%) in candy prepared from Lalit whereas; candy from Sardar variety had highest potassium (57.99 mg/100g), calcium (9.39 mg/100g) and vitamin C (41.22 mg/100g). Punjab Pink and Sardar variety were considered better for candies in terms of nutritional quality. However, candies prepared from other guava varieties also had a high nutritional profile and good acceptability.

Keywords: Candy, guava varieties, nutritional composition, organoleptic evaluation

Introduction
Guava is one of the most delicious and nutritious fruit, liked by the consumers for its refreshing taste and pleasant flavor. It excels most other fruit crops in productivity, hardness and adaptability. Guavas have sweet musky odour which is pungent and penetrating and a sweet-sour taste with a little astringency. Due to their astringent properties mature guava fruits, leaves, bark and immature fruits are used to treat gastroenteritis, diarrhoea and dysentery (Ojewole *et al*. 2008) [15]. Picked at the right stage of maturity, fruits on ripening give excellent taste and flavor, characteristic of a particular cultivar. Guava is broadly classified into two distinct types-white-fleshed varieties and pink-fleshed varieties. Guava (*Psidium guajava* L.) is valued as a potential source of pectin, ascorbic acid (vitamin C), sugars and minerals (Hassimotto *et al.* 2005) [6].

Guava fruits are relished when mature or ripe and freshly plucked from the tree. However, guava being a climacteric fruit ripens rapidly after harvest, therefore, has a short shelf-life. Because of this fact, it becomes necessary to utilize the fruit for making different preserved products in order to ensure its availability over a longer period of time. Guava has a potential of being processed into innumerable value added products such as jam, jelly, juice, nectar, puree, fruit bar and dehydrated products.

Candy is a sweet food prepared from fruits or vegetables by impregnating them with sugar syrup followed by draining of excessive syrup and then drying the product to a shelf stable state (Girdhari 1986) [9]. The foremost benefit of processing fruit into candy is that it can be stored for a long period at ambient temperature as intermediate moisture product with high solids content (Bhatia *et al.* 1964) [4]. Hence, the present investigation was carried out to utilize different guava varieties for the preparation of candy and to determine their sensory and nutritional quality.

Materials and Methods
The study was conducted at the Department of Food and Nutrition, College of Home Science, Punjab Agricultural University, Ludhiana (Punjab) during the year 2015-2016.

Slightly unripe and hard fruits of six guava varieties - Sardar, Shweta, Hisar Safeda that were white-fleshed and Lalit, Punjab Pink, Hisar Surkha that were pink-fleshed were procured from Regional Fruit Research Station, Patiala, Punjab and brought to the laboratory for processing. Other ingredients i.e. sugar and citric acid was purchased from the local market of Ludhiana.

Development of guava candy: Guava fruits were cleaned of dirt, dust, and other impurities prior to processing. The fruits were then peeled and cut to remove the seeds and made into slices of desired shape and size. Blanching was done for three minutes and the pieces were spread on clean tray to dry off the excess moisture. Thereafter, sugar syrup prepared by adding sugar (400g) and water (400ml) was poured over the guava pieces into a deep vessel and the pieces were kept immersed in the syrup for 24 hours. Next day, the concentration of the syrup was raised to 50° Brix by adding sugar and the syrup was poured over guava pieces. The process was repeated until the syrup strength reaches 60° Brix and citric acid (1.5g) was added to it at this stage. The syrup strength was finally raised to 68° Brix and the guava pieces were left in the syrup for a week. On the eighth day, syrup was drained off and fruit pieces were dried in oven at 55 to 60 °C for 5 to 6 hours. Guava candy was rolled in ground sugar and packed in glass jars.

Organoleptic evaluation of guava candies: The sensory evaluation of candies developed from different guava varieties was carried out using a 9-point hedonic scale as described by Larmond (1970) [10]. A panel consisting of ten semi-trained judges assessed the samples on the sensory attributes like appearance, colour, texture, flavour and overall acceptability to determine the most acceptable variety for candy.

Nutritional estimation of candies: Guava candies were chemically analyzed for proximate composition i.e. moisture, protein, fat, crude fiber and ash content according to the standard procedures of AOAC 2000 [1]. The total carbohydrate in the chutney was determined by difference. Concentrations of minerals-calcium, phosphorus and potassium were determined by running the diluted samples through Atomic Absorption Spectrophotometer (AAS, Varian model) after wet digestion (Piper 1950) [16]. Vitamin C was determined colorimetrically (AOVC 1996) [2] and estimation of total carotenoid contents was carried out using UV/visible spectrophotometer at 450 nm as described by Zakaria *et al*. (1979) [22].

Statistical analysis of the data: The sensory scores were analysed using Kruskal Wallis test to select the most acceptable variety for guava candy. Data related to the nutritional composition of guava candies was statistically analysed and interpreted by analysis of variance and p values ≤0.5 were considered significant. Tukey's test was used to compare the difference among the mean values. All statistical analysis was done using SPSS package programme version 17.

Results and Discussions

Sensory evaluation of guava candies

Data presented in Table 1 shows the mean sensory scores for candy prepared from six different varieties of guava. The statistical analysis showed that the scores for all the sensory parameters were significantly different (p<0.05) for the candies developed from different cultivars. However, all the candies were found to be acceptable. Among the white fleshed varieties Hisar Safeda scored highest (7.44) in terms of overall acceptability followed by Sardar (6.59) and Shweta (6.57). For the pink fleshed varieties, candy prepared from Punjab Pink had highest overall acceptability (7.55) followed by Lalit (6.53) and Hisar Surkha (6.36). Previous study has shown that the sensory scores for candy prepared from Punjab Pink variety were highest for pretreatment with 0.5% sodium bisulfate and minimum with 0.2% potassium metabisulfite (Kumar *et al*. 2017) [8].

Table 1: Mean sensory scores for *candy* prepared from white and pink fleshed guava varieties

Varieties	Parameters				
	Appearance	Colour	Texture	Flavour	Overall Acceptability
White Fleshed Varieties					
Sardar	6.7	6.6	6.4	6.65	6.59
Shweta	6.3	6.2	7.7	6.1	6.57
Hisar Safeda	7.6	7.7	6.8	7.65	7.44
χ^2 value	14.12*	12.40*	10.78*	13.1*	7.73*
Pink Fleshed Varieties					
Lalit	6.6	6.7	6.6	6.2	6.53
Punjab Pink	7.5	7.6	7.8	7.3	7.55
Hisar Surkha	6.2	6.1	6.8	6.35	6.36
χ^2 value	10.60	10.92	11.76	11.08	11.88

*Significant at 5% level of significance (p<0.05)

Nutritional composition of guava candies

Proximate composition

Guava candies developed from different varieties were analysed for moisture, crude protein, crude fat, total ash and carbohydrates, the data for which is presented in Table 2. The proximate composition of the candies varied significantly (p <0.05) for all the components except for crude fat. The moisture content among guava candies ranged between 6.90% (Punjab Pink) - 9.20% (Sardar). Kumar *et al.* (2017) [8] observed 8.56% moisture in candy prepared from Punjab Pink guava. The low moisture content of the guava candy is a good indicator of the increased shelf life of the product. Madan and Dhawan (2005) [12] have reported moisture content values of 16.2, 14.2 and 21.0%, respectively in fresh carrot candies in sugar, in sugar and coconut powder and in jaggery. Crude protein content varied from 0.28 - 0.42% among the candies. The highest protein content was observed in candy made from Lalit whereas lowest was found in Sardar. Protein content decreased from 3.6% in fresh bael fruit to 3.18% in bael candy (Singh *et al.* 2017) [19]. Crude fat in the guava candies ranged between 0.15-0.24%. Crude fiber in the candies prepared from different varieties was found to be between 3.87-5.21%. The highest fiber content was present in Punjab Pink candy while lowest was recorded in candy developed from Lalit variety. Total ash content in the guava candies varied from 0.39-0.57%, being highest in Punjab Pink candy. Carbohydrate content ranged from 87.23 - 85.09% among the candies. High carbohydrate content of the candies may be attributed to the addition of large amount of sugar in the preparation of candy. Durrani *et al.* (2011) [5] found 78% total sugars in honey based carrot candy whereas Kaikadi *et al.* (2006) [7] observed 77% total sugars in ber candy.

Table 2: Proximate composition of candy made from different guava varieties (DW basis)

Varieties	Moisture (%)	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Total Ash (%)	Carbohydrates (%)
White Fleshed Varieties						
Sardar	$9.20^{a} \pm 0.01$	$0.28^{c} \pm 0.01$	0.24 ± 0.02	$4.80^{b} \pm 0.14$	$0.39^{c} \pm 0.01$	$85.09^{d} \pm 0.11$
Shweta	$8.66^{ab} \pm 0.22$	$0.34^{abc} \pm 0.03$	0.17 ± 0.01	$4.50^{bc} \pm 0.04$	$0.40^{c} \pm 0.02$	$85.91^{cd} \pm 0.27$
Hisar Safeda	$7.47^{c} \pm 0.12$	$0.39^{ab} \pm 0.01$	0.19 ± 0.02	$4.27^{c} \pm 0.03$	$0.42^{bc} \pm 0.03$	$87.23^{a} \pm 0.06$
Pink Fleshed Varieties						
Lalit	$8.89^{a} \pm 0.05$	$0.42^{a} \pm 0.02$	0.23 ± 0.01	$3.87^{d} \pm 0.06$	$0.48^{c} \pm 0.02$	$86.11^{bc} \pm 0.03$
Punjab Pink	$6.90^{c} \pm 0.19$	$0.36^{abc} \pm 0.01$	0.15 ± 0.03	$5.21^{a} \pm 0.07$	$0.57^{a} \pm 0.03$	$86.79^{ab} \pm 0.31$
Hisar Surkha	$8.22^{b} \pm 0.11$	$0.32^{bc} \pm 0.02$	0.21 ± 0.02	$4.65^{bc} \pm 0.09$	$0.55^{ab} \pm 0.02$	$86.05^{bc} \pm 0.08$

Values are given as Mean ± SE

Figures with different superscripts are significantly different (p<0.05)

Mineral content

The candy prepared from six different varieties of guava were analysed for calcium, phosphorous and potassium content which is presented in Table 3. Calcium content in the candies was found to be between 7.72-9.39 mg/100 g. It was found to be higher in the candies from white flesh varieties. The phosphorus content of the guava candy ranged from 13.73 mg for Sardar to 16.70 mg for Punjab Pink. Potassium in the candies ranged between 46.27-57.99 mg which was highest for candy prepared from Sardar and lowest for Hisar Safeda.

Table 3: Mineral content of the candy developed from different varieties of guava

Varieties	Calcium (mg/100 g)	Phosphorus (mg/100 g)	Potassium (mg/100 g)
White Fleshed Varieties			
Sardar	$9.39^{a} \pm 0.03$	$13.73^{c} \pm 0.09$	$57.99^{a} \pm 0.20$
Shweta	$9.09^{ab} \pm 0.04$	$14.55^{bc} \pm 0.21$	$51.08^{bc} \pm 0.71$
Hisar Safeda	$8.35^{bcd} \pm 0.26$	$15.11^{b} \pm 0.11$	$46.27^{d} \pm 0.25$
Pink Fleshed Varieties			
Lalit	$8.73^{abc} \pm 0.16$	$14.09^{c} \pm 0.14$	$48.73^{cd} \pm 1.32$
Punjab Pink	$7.72^{d} \pm 0.21$	$16.70^{a} \pm 0.19$	$54.16^{b} \pm 0.35$
Hisar Surkha	$8.15^{cd} \pm 0.10$	$16.16^{a} \pm 0.38$	$53.30^{b} \pm 1.18$

Values are given as Mean ± SE

Figures with different superscripts are significantly different (p<0.05)

Vitamin C and total carotenoids

The ascorbic acid and total carotenoid content in candy prepared from different guava varieties has been presented in Table 4. Vitamin C in the candies was found to be between 28.17-41.22 mg/100g. Sardar variety had the highest vitamin C content whereas least vitamin C content was observed for Hisar Surkha. The decrease in vitamin C has been attributed to blanching and cooking processes. Kumar *et al.* (2017) [8] observed 43.74 mg Vitamin C in Punjab Pink candy. Pruthi (1999) [17] reported loss of ascorbic acid during blanching of different vegetables ranged from 10-20% and sometimes even more depending upon the nature, temperature and method of blanching. Unde and Jadhav (1998) [21] found a decrease in the level of moisture content and ascorbic acid in ber candy prepared from both hot and cold syruping method as compared to the fresh ber fruit. Ascorbic acid content was found to decrease in blanched carrots due to leaching in water and thermal degradation (Lee and Kader 2000) [11]. A decrease in vitamin C content of amla candy was also reported by Tripathi *et al.* (1988) [20].

The carotenoid content was found to differ significantly in the candy prepared from pink fleshed guavas. It was highest for Punjab Pink candy with 4.90 mg/100 g carotenoids whereas for Lalit and Hisar surkha candy it was 4.1mg/100g and 3.2 mg/100g respectively. Carotenoids were not detected in candy prepared from white varieties. Sian and Soleha (1991) [18] stated that levels of carotenoids decrease progressively as blanching time and temperature increases. Mehta and Bajaj (1984) [13] reported a total loss of ascorbic acid along with loss in carotenoids, flavonoids and phenols during preparation of candied peel from three different kinds of citrus fruits. Baloch *et al.* (1987) [3] observed that blanching pre-treatment was very effective in protecting carotenoids in dehydrated carrots. Mohamed and Hussain (1994) [14] found that long drying time adversely affects the ascorbic acid content than high drying temperature while carotenoids were more sensitive to high drying temperature than drying time.

Table 4: Vitamin C and total carotenoid content of candy developed from different varieties of guava

Varieties	Vitamin C (mg/100g)	Total Carotenoids (mg/100g)
White Fleshed Varieties		
Sardar	$41.22^{a} \pm 0.23$	-
Shweta	$30.53^{cd} \pm 0.13$	-
Hisar Safeda	$34.47^{bc} \pm 0.31$	-
Pink Fleshed Varieties		
Lalit	$37.31^{ab} \pm 1.14$	$4.10^{ab} \pm 0.36$
Punjab Pink	$35.06^{b} \pm 1.24$	$4.90^{a} \pm 0.35$
Hisar Surkha	$28.17^{d} \pm 1.41$	$3.20^{b} \pm 0.21$

Values are given as Mean ± SE

Figures with different superscripts are significantly different (p<0.05)

Conclusion

The post-harvest loss of fruits is one of the most pressing problems of the fruit industry especially in the tropical countries like India. This can be dealt with value addition of the seasonal crops. The present study clearly depicts that guavas being a climactric fruit can successfully be utilized for the development of candy which may ensure better post-harvest management together with extending its availability over time. The candies thus prepared have a good nutritional profile. Sensory evaluation of candy revealed that candies prepared from Punjab Pink and Hisar Safeda were most acceptable. Thus, the results showed that the newly developed guava varieties can be effectively used for the development of low cost, delightful and nutritious guava candy at household or commercial level.

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