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Development and Quality Evaluation of Guava (cv. Punjab Pink) Candy

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ABSTRACT

Fresh guava fruits (Punjab Pink) were processed to make guava candy, after removal of peel and seeds and yield recorded as 64.66 per cent. Pricked guava pieces were pretreated using two levels of each potassium metabisuphite ($T_{1=}$ 0.2, T_2= 0.5%) and sodium bisulfite (T_3=.2 and T_4= 0.5%) for 10 min, prior to candy preparation. Guava candy was prepared and stored for 6 months under ambient condition in pearl pet jars. Physico-chemical analysis of guava candies during storage period revealed that T4 treatment accomplished best for quality, biochemical properties and colour characteristics. Land b values of samples decline whereas a*values elevated significantly. Maximum overall acceptability score (8.62) was eminent for T4 followed by T3 (8.58), T2 (8.08), T1 (7.68) and minimum for control sample (6.97) at end of storage period. Therefore, it can be concluded that the most acceptable and shelf stable product can be prepared from sodium bisulfite treated guava fruit (treated @ 0.5%).*

Key words: *Guava (cv. Punjab Pink), Candy, Physico-Chemical, Colour, Storage*

INTRODUCTION

Guava (*Psidium guajava* L.) is one of the major fruit crop broadly cultivated in India after mango, banana and citrus. It belongs to the *Myrtaceae* family and is a native of tropical and sub-tropical regions. It is considered as one of the best and cheapest fruit of India because of its excellent digestive and nutritive value, pleasant flavour, high palatability and availability in abundance at affordable prices. Guava, a biennial crop, is a rich in pectin, fiber, folic acid, minerals like potassium, copper, manganese, calcium, iron, phosphorus and vitamins like ascorbic acid, thiamine, riboflavin, nicotinic acid and vitamin A. The fruit being rich in many phytochemicals resulted in increasing its demand in food industry because of its therapeutic value[1]. Among the various guava varieties grown, Punjab Pink variety has gained special attention due to its high yield, pleasant flavour and attractive pink colour.

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Guava fruit being a perishable in nature cannot be stored for more than two days in rainy season and 6-8 days in winter and can also be easily subjected to heavy infestation and finally, the guava season is very short resulting in a glut in the market[2].Thus, it can be processed into innumerable value added products to lessen the losses and stabilize the cost.Processed guava products such as puree, paste, canned slices in syrup or nectar have been developed and marketed. Guava juice is also used for manufacturing of instant guava powder available for formulated drinks, baby foods and other confectionary products. However, not much study has been done for developing guava candy especially from Punjab pink variety. The candied fruits may be used in baking industry for preparation of cakes, cookies, steamed puddings, sweet breads etc[3]. 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[4]. Candy manufacturing beneficial to both the farmers as well as the entrepreneurs because of minimum equipment requirement and cost effective process.Guava candy is an appealing economical product with good nutritional values. Keeping all these facts in view, the present study was carried out with the objective to assess the suitability of different levels of potassium metabisuphite and sodium bisulfite on the guava candy and to evaluate their effect on the physicochemical properties and sensory quality and to assess the storage stability of guava candy.

MATERIAL AND METHODS

Punjab Pink variety of guava was procured from Regional Fruit Research Centre, Bahadurgarh, Patiala of Punjab Agricultural University, Ludhiana. Before processing, the fruit was washed, peeled and core removed contains seeds portion, then the fruit was cut into 0.5 inch sized pieces. These pieces were then pricked with stainless steel fork and dipped in the chemical solutions (T_1-0.2% KMS, T_2-0.5% KMS, T_3-0.2% Sodium bisulfite and T_4-0.5% Sodium bisulfite) for 10 minutes. The pricked and pre-treated guava fruit pieces were soaked in 50.0 per cent sugar solution containing 0.3 per cent citric acid and kept at room temperature overnight. The strength was raised by 8-10 per cent by adding sugar and concentrating the syrup after a day. The pieces were soaked overnight and the process was repeated for 3-4 days till the total soluble solids (TSS) of syrup reached 70°Brix. The contents were kept for 7 days at room temperature. The syrup was then drained off and guava pieces were dried in a cabinet drier at 55° ± 5°C beyond sticky condition. The guava candies were stored in PET jars for further storage studies of 6 months at ambient conditions (as shown in fig. 1).

Sorting and grading
↓
Washing
↓
Weighing
↓
Peeling
↓
Decoring and segmentation (0.5 inch)
↓
Piercing
↓
Chemical dipping for 10 minutes
(0.2 and 0.5% KMS and sodium bisulfite, respectively)
↓

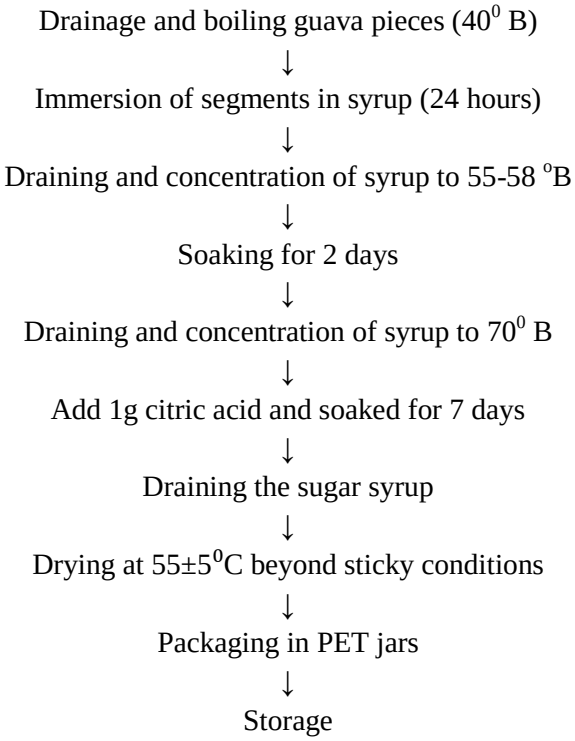

Fig. 1: Flowchart of candy making

Fresh fruit and candy were analyzed for moisture (%) as per AOAC (2000) and total soluble solids (°B) by using hand refractometer (Erma, Japan). Titratable acidity was evaluated by titrating known volume of aliquots against 0.1 N NaOH and expressed as per cent citric acid[5], total sugars and reducing sugars were estimated as per Lane and Eynon method[6]. Crude fibre was assessed by acid-alkali method (Fibertec, FOSS) [6]. Ascorbic acid was determined using titrimetric method and expressed as mg/100g and lycopene content (mg/100g) using spectrophotometric method[5]. Prepared candies were evaluated for sensory attributes such as appearance, colour, flavour, body/texture and overall acceptability using 9- point hedonic scale [6]. Colour analysis was performed using Hunter Lab Colorimeter, Minis can XE Plus (Hunter Lab, Reston, VA). Colour readings were expressed by Hunter values for L*, a* and b*. The a* value ranged from −100 (greenness) to +100 (redness), the b* value ranged from −100 (blueness) to +100 (yellowness), whereas L value, indicating the measure of lightness, ranges from 0 (black) to 100 (white) [8]. The data collected for different characteristics were analyzed with the help of Factorial Completely Randomized Design[9].

RESULTS AND DISCUSSION

Physico-chemical composition of fresh guava fruit (cv. Punjab Pink)

The physice-chemical quality of fresh guava fruit presented in Table 1. Moisture content in fresh fruit was recorded as 79.50 per cent and TSS as 10.5°B. Aulakh[10] observed slightly higher TSS value (11.5°B) for apple colour guava variety. Titratable acidity was recoded as 0.38 per cent indicating slightly acidic nature of the fruit. Guava fruit has been recognized as a major source of vitamin C and its content in Punjab Pink variety was 198.49 mg/100 g. Total and reducing sugar content was 10.73 and 4.75 per cent, respectively in fresh fruits while lycopene content of fresh guava fruits of Punjab Pink was 3.74 mg/100 g. However, Boora [10] reported higher lycopene content as 7.45 mg/100 g. The variation might be due to the growing season of crop. The crude fibre content in Punjab Pink was noted as 8.13 per cent and the results are similar to the one reported by Tanwar[12], where the authors recorded 9.1 per cent crude fibre in guava fruits. The color values namely L, a* and b* of pink guava fruit were noted as 44.14, 15.51 and 6.26, respectively as presented in table 1.

Table 1: Physico-chemical composition of fresh guava

Character	PunjabPink
TSS (°Brix)	10.5
Moisture (%)	79.50
TitratableAcidity (%citricacid)	0.38
AscorbicAcid (mg/100g)	198.49
Reducingsugars (%dextrose)	4.75
TotalSugars (%dextrose)	10.73
Lycopene (mg/100g)	3.74
Crudefibre (%)	8.13
Color:	
L	44.14
a*	15.51
b*	6.26

Changes in physico-chemical composition of guava candy during storage

Effect of chemical treatment on physico-chemical composition of fresh and stored guava candy has been presented in Table 2 and 3. Moisture content of any product is the predominant parameter in defining the stability and thus shelf life. Significant ($p \leq 0.05$) losses in the moisture content of candies occurred during storage period of 6 months (Table 2). Highest moisture content loss was recorded in T_4 (54.8%) and minimum in T_3 (50.80%) candies. The decrease in moisture content seemed to be due to natural dehydration of product during storage[3]. Similar trend of decreasing moisture content was reported by Mehta[13] and Sharma[14] in lemon peel candy and apple candy, respectively. Total soluble solids of candies increased significantly ($p \leq 0.05$) during the storage of 6 months. The maximum increase in total soluble solids occurred in T_1 treatment (81.52° B) followed by T_2, T_3 and T_4 while lowest in control (Table 2). This change seemed to be the result of moisture loss of the samples. Also, increase in TSS values might be attributed to breakdown of the complex carbohydrates into simple soluble carbohydrates[14]. Similar observations were reported by Sharma[13] in apple candy.

Storage had significant effect ($p \leq 0.05$) on titratable acidity of candies which decreased with time (Table 2). Titratable acidity exhibited maximum decrease in treatment T_1 of Punjab pink guava candy and was noted as 0.22 to 0.16 per cent while T_4 recorded least decrease from 0.25 to 0.22 per cent after termination of storage period of 6 months. Apparently decrease in titratable acidity values can be ascribed to the reaction of acids with basic minerals in the product or loss of acids mainly due to ascorbic acid during the processing of candy. It was observed that 0.5 per cent KMS and sodium bisulfite treatment resulted in good quality guava candies as compared to 0.2 per cent KMS treatment. The residual ascorbic acid content in the guava candy prepared from Punjab Pink at different storage intervals (Table 2) decreased significantly ($p \leq 0.05$) for all the treatments during the storage of candies. The initial concentration of ascorbic acid in candies was recorded in the range of 43.74 to 81.39 mg/100 g. The minimum loss of ascorbic acid content during storage of 6 months was recorded in T_4 (38%) while control sample recorded maximum loss of ascorbic acid as 61.9 per cent.

The loss in ascorbic acid content was found to be due to the effect of light and prevailing high room temperature conditions. Similarly, ascorbic acid losses pattern in ber candy was reported by Kaikadi[15]. The results after 6 months storage period of candies revealed that the chemical pre-treatments of KMS and sodium bisulfite given to candies at higher (0.5%) concentration was more effective as compared to 0.2 per cent treatments of both KMS and sodium bisulfite. Statistically, the effect of treatments, storage and interaction on ascorbic acid content of Punjab Pink guava candy was found to be significant ($p \leq 0.05$).

The mean value of reducing sugars for control guava candy was recorded as 37.54 per cent (Table 3)and among the treatments, highest mean of reducing sugars content was found in T_3 (38.51%). The reducing sugar content during the storage was maximum in T_2 (23.43%) and lower in T_3 (20.59%). For total sugars, also same results were observed as maximum in T_2 candies (21.09%) and minimum increase was observed in T3 (18.15%). Treatment of guava for preparing candies with KMS resulted in higher increase of reducing and total sugars (23 and 21%, respectively) as compared to guava candies treated with sodium bisulfite (21 and 19%, respectively). Moisture loss and inversion of sucrose were considered as the prime reason for the increase in reducing and total sugars content[14]. The effect of treatments and storage on the lycopene content has been presented in Table 3. The amount of lycopene content is a major factor for therapeutic and medicinal value of the guava products. Moreover, lycopene content is well known to have their influence on the colour of the guava products. Freshly prepared control candy had lycopene content as 7.74 mg/100g. The maximum retention of lycopene content was observed in T_1 (52.08%) after storage of 6 months. The effect of storage on lycopene content of guava candy showed that chemical treatments with KMS and sodium bisulfite at lower concentration (0.2%) were more beneficial in preventing the loss of lycopene than at higher concentration (0.5%) which resulted in higher retention of lycopene in the final product. Data clearly depicted the considerable loss of lycopene during treatment and storage conditions. Storage period and treatments had shown significant effect ($p \leq 0.05$) on the lycopene content of the product during 6 months of storage studies. However, interaction between treatments and storage had non-significant effect.

Behaviour of the crude fibre content in guava candies prepared from Punjab Pink during storage has been listed in Table 5. In general, crude fibre content increased and highest increase was observed in treatment T_3 (26.53%) and lower increase was found in T_2 (16.66%) after 6 months storage period. This increase in crude fibre content might be due to moisture loss of product during storage. Similar results were reported by Sandhu[16] in papaya candy where the crude fibre content increased from 2.47 to 3.91 per cent after 5 weeks of storage.

Table 2: Effect of treatments and storage on moisture content, total soluble solids, titratable acidity and ascorbic acid of guava candy (Punjab Pink)

Treatments	Storage period (months)			
	0	2	4	6
Moisture Content (%)				
Control	8.56	5.42	4.65	4.16
T_1	8.21	5.04	4.33	3.95
T_2	8.24	5.15	4.34	4.04
T_3	8.66	5.52	4.76	4.26
T_4	8.43	5.34	4.63	3.82
Total soluble solids (° B)				
Control	73.27	74.34	75.17	77.25
T_1	75.22	77.52	79.85	81.52
T_2	70.38	74.24	76.33	78.11
T_3	72.16	73.45	75.28	76.91
T_4	70.20	72.22	74.17	76.46
Titratable acidity (%)				
Control	0.33	0.24	0.19	0.19
T_1	0.22	0.20	0.17	0.16
T_2	0.30	0.28	0.26	0.26
T_3	0.25	0.23	0.23	0.22
T_4	0.25	0.23	0.24	0.22
Ascorbic acid(mg/100g)				
Control	43.74	27.29	20.21	16.63
T_1	52.64	38.61	33.51	29.51
T_2	76.44	59.75	51.45	44.65
T_3	61.47	43.47	36.15	32.75
T_4	81.39	64.64	55.44	50.74
$LSD_{0.05}$				
Source	**Moisture Content (%)**	**Total soluble solids (° B)**	**Titratable acidity (%)**	**Ascorbic acid(mg/100g)**
Treatment (T)	0.04	0.12	0.002	1.48
Storage (S)	0.04	0.11	0.002	1.28
T x S	0.09	0.25	0.004	2.85

LSD - Least Significant Difference @ 0.05

Table 3: Effect of treatments and storage on reducing sugar, total sugar, lycopene and crude fiber of guava candy (Punjab Pink)

Treatments	Storage period (months)			
	0	2	4	6
Reducing sugars (% dextrose)				
Control	37.54	41.77	44.65	47.73
T_1	35.90	40.83	43.74	46.80
T_2	35.26	44.15	42.98	46.05
T_3	38.51	43.08	45.33	48.50
T_4	35.19	38.87	41.68	45.24
Total sugars (% dextrose)				
Control	76.84	84.39	89.30	94.53
T_1	73.27	82.50	87.49	92.68
T_2	71.96	89.20	85.96	91.20
T_3	78.61	87.05	90.67	96.05
T_4	71.82	78.54	83.37	89.66
Lycopene (mg/100g)				
Control	7.74	6.97	6.27	5.43
T_1	7.45	5.98	4.84	3.88
T_2	7.57	5.64	4.78	3.87
T_3	7.66	5.51	4.58	3.65
T_4	7.64	5.48	4.62	3.54
Crude fiber (%)				
Control	5.59	5.99	6.37	6.71
T_1	6.89	7.59	8.27	8.94
T_2	6.80	7.28	7.74	8.16
T_3	6.45	7.26	8.04	8.78
T_4	6.78	7.32	7.83	8.28
	$LSD_{0.05}$			
Source	**Reducing sugars (%)**	**Total sugars (%)**	**Lycopene** (mg/100g)	**Crude fiber (%)**
Treatment (T)	0.05	0.04	NS	0.04
Storage (S)	0.04	0.04	NS	0.06
T x S	0.09	0.09	NS	0.09

LSD - Least Significant Difference @ 0.05

Changes in Hunter colour values (L, a*, b*) of guava candy during storage

The changes in L, a* and b* values for Punjab Pink guava candy during 6 months storage period have been listed in Table 4. Control samples had lowest L values (44.19) and among the treatments, T_3 had highest L values of 55.03 whereas minimum value was recorded in T_2 as 45.93. The a* value ranged from 29.73 to 17.93 whereas b* values ranged from 26.12 to 19.73 while control samples having 15.51 and 6.26, a* and b* values, respectively, in the beginning of storage period. A gradual increase in a* values indicating increase of redness and gradual decrease of b* values indicating gradual loss of yellowness was observed in all samples during 6 months of storage. Lowering of L values during storage could be attributed to formation of dark coloured compounds from non-enzymatic browning reactions, like Maillard's reaction[17], oxidation of organic acids or precipitation of pigments[18], giving darker appearance. Statistically, treatments, storage and interaction between treatments and storage had significant effect ($p \leq 0.05$) on colour attributes (L, a***** and b*****) of guava candies.

Sensory evaluation of guava candies

The effect of chemical treatments on the sensory attributes of the candies is represented in Table 4. The maximum overall acceptability scores for pink guava candy were noted as 8.73 for T_4 and minimum for T_1 as 7.13. The overall acceptability scores declined during storage period of 6 months, which might be due to degradation of guava candy in terms of colour, taste and nutritive value. The overall acceptability scores declined during storage period of 6 months, which might be due to degradation of guava candy in terms of colour, taste and nutritive value. Individually, treatments and storage had significant ($p \leq 0.05$) effect on flavour values of guava candies but interaction between the two had non-significant effect.

Table 4: Effect of treatments and storage on hunter color values and overall acceptability scores of guava candy (Punjab Pink)

Treatments	Storage period (months)			
	0	2	4	6
L*				
Control	44.19	43.02	42.92	41.71
T_1	49.32	46.12	43.92	41.05
T_2	45.93	43.12	41.92	39.60
T_3	55.03	53.12	50.93	40.12
T_4	46.32	43.93	40.12	38.51
a*				
Control	15.51	12.42	10.12	9.92
T_1	20.12	17.32	13.74	10.28
T_2	17.93	14.13	11.47	9.32
T_3	25.12	21.43	15.71	11.24
T_4	29.73	22.12	17.62	13.88
b*				
Control	6.26	8.92	11.23	12.95
T_1	25.32	22.93	19.04	18.61
T_2	26.12	22.73	19.67	10.90
T_3	19.73	17.32	15.92	14.00
T_4	20.93	18.12	16.93	15.04
Overall acceptability scores				
Control	7.47	7.17	6.77	6.47
T_1	8.10	7.93	7.57	7.13
T_2	8.53	8.37	7.97	7.47
T_3	8.70	8.53	8.57	8.53
T_4	8.73	8.59	8.60	8.57
		$LSD_{0.05}$		
Source	L	a*	b*	Overall acceptability scores
Treatment (T)	0.06	0.06	0.05	0.28
Storage (S)	0.05	0.06	0.05	0.25
T x S	0.11	0.13	0.10	NS

LSD - Least Significant Difference@ 0.05

CONCLUSION

Punjab pink variety of guava has good potential for candy preparation. Sodium bisulfite treated guava candies maintained firm texture throughout the storage period as compared to KMS treated candies that started developing tough and leathery texture after 4 months of storage onwards. Sodium bisulfite treatment at 0.5 per cent concentration was found best for candy preparation with respect to physico-chemical as well as organoleptic attributes though the KMS treated candies also fall under acceptable range. Storage study showed that guava candies can be stored safely for 6 months at ambient temperature without significant changes in sensory attributes.

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