

Original Research Article

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## Organoleptic Properties of Guava Fruit Leather with Effectiveness of Increase in Storage Period

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### ABSTRACT

An investigation was carried out to study the effect of storage period on organoleptic properties of guava leather prepared from its cultivars of Sardar (white flesh) and Lalith (pink flesh). Preliminary experiments were conducted to find out the optimum levels of sugar, citric acid and salt for preparation of quality leather. The leather prepared was packed in butter paper and stored at ambient ( $25\pm 2^{\circ}\text{C}$ ) and refrigerated temperature ( $5\pm 2^{\circ}\text{C}$ ) for 90 days to study their storage feasibility. Out of the seven treatments, best two  $T_1$ ,  $T_2$  are selected for further storage period of 90 days by sensory panel members on 9 point hedonic scale rating. The stored samples were drawn periodically at 30 days interval for analysis. The guava leather (625.76 g/kg pulp) was obtained from treatment  $V_1T_1$  (750g sugar + 5g salt + 2g citric acid), followed by the other treatments (618.06 g/kg pulp) in  $V_1T_2$  (750 g sugar) for Sardar guava variety, (624.00 g/kg pulp) in  $V_2T_1$  (750 g sugar + 5g salt + 2g citric acid) and (617.00 g/kg pulp) in  $V_2T_2$  (750 g sugar) for Lalith guava variety. The treatments  $V_1T_1$ ,  $V_2T_1$ , and  $V_1T_2$ ,  $V_2T_2$  are same but mainly differ in cultivars of guava white and pink flesh. Chemical composition indicated that the fresh guava leather contained on an average 16.80 per cent moisture, 76.20<sup>0</sup>Brix TSS, 14.36 per cent reducing sugars, 68.70 per cent total sugars, 0.541 per cent titrable acidity, 127.10 mg/100 g ascorbic acid. The guava leather prepared by using sugar, salt, citric acid (Treatment  $V_1T_1$  and  $V_2T_1$ ) were superior over the other treatments in respect of organoleptic properties. The mean score of fresh guava leather for colour and appearance was 8.60, flavor 8.50, texture 8.60, taste 8.30 and overall acceptability 8.50 on 9 point Hedonic scale. The storage studies indicate that there was a gradual decrease in organoleptic properties of leather with advancement of storage period. Sensory quality of guava leather decreased at faster rate during storage, which was more at ambient temperature than refrigerated storage. Total microbial count was low initially but increased slightly during storage. However guava leather was found to be acceptable in good condition even after 90 days of storage at ambient and refrigerated temperature.

#### Keywords

Guava, Lalith, Sardar, Leather, storage

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### Introduction

Guava (*Psidium guajava* L.) is a member of dicotyledonous, belong to large member of Myrtaceae or Myrtle family believed to be

originated in Central America and Southern part of Mexico (Somogyi *et al.*, 1996). It is a small tree or shrub of 2 to 8 m in height with

wide spreading branches (Singh 1988). In India it is claimed to be the fourth most important cultivated fruit in both area and production wise after mango, banana and citrus (Singhal, 1996). Whole guava fruit is edible along with skin, quite hardy, prolific bearer with sweet aroma and pleasant sour sweet taste, considered as one of most delicious and luxurious fruits, often marketed as “Super fruits”.

The quality and nutritional value of guava fruits are influenced by physical and biochemical changes during maturation by photosynthesis and accumulation. Fully mature guava fruits have very strong flavour therefore it is unsuitable to use as a table purpose. The fruit has about 83% moisture and is an excellent source of ascorbic acid (100 – 260 mg/100 g pulp) and pectin (0.5 – 1.8 %) (Verma and Shrivastava, 1965), but has low energy (66 Cal/100 g) and protein content (1%) (Bose *et al.*, 1999). The fruit is rich in minerals like phosphorous (23-37 mg/100 g), calcium (14-30 mg/100 g), iron (0.6-1.4 mg/100 g), as well as vitamins like Niacin, Pantothenic acid, Thiamine, Riboflavin, vitamin A (Bose *et al.*, 1999).. Guava is normally consumed fresh as a desert fruit can be processed into juice, nectar, pulp, jam, jelly, slices in syrup, fruit bar or dehydrated products, as well as being used as an additive to other fruit juices or pulps (Leite *et al.*, 2006). Excellent salad, pudding, jam, jelly, cheese, canned fruit, RTS, nectar, squash, ice cream and toffees are made from guava (Jain and Asati, 2004). However, guava is highly perishable and cannot be stored for longer period. Moreover considerable proportion of the produce is lost during post-harvest linkage (Ahire, 1989). It is, therefore, imperative to develop suitable technology for preservation and processing of such surplus produce. There has been greater increase in the production rate of these fruits over the years, and this may be due to their increased consumption pattern in the tropics (FAO, 1983). It is common

experience that 20-25% of the fruit is completely damaged and spoiled before it reaches the consumer (Yadav, 1997). Therefore, to utilize the produce at the time of glut and to save it from spoilage; the development of low cost processing technology of guava is highly required. It will also generate enough opportunities of self-employment by starting small scale processing unit or cottage industry that will be remunerative to the growers. Thus the preparations of guava pulp with simple technology and its utilization in the form of pulp and leather have a great scope.

Fruit leathers are dehydrated fruit based products. They are a tasty, chewy, dried fruit product. Fruit leathers are made by pouring pureed fruit onto a flat surface for drying. When dried the fruit is pulled from the surface and rolled, it gets the name “Leather” from the fact that when the pureed fruit is dried, it is shiny and has the texture of leather. Due to its novel and attractive structure, and for being products that do not require refrigeration, they constitute a practical way to incorporate fruit solids, especially for children and adolescents. Fruit leathers allow leftover ripe fruits to be preserved. Therefore guava leather from two kinds of fully ripened guava fruits one is of white flesh of Sardar variety and another of pink flesh Lalith fruits is prepared and kept for storage period of 3 months for organoleptic studies at both ambient and refrigerated storage.

## **Materials and Methods**

### **Raw materials**

Well-matured, healthy, uniform sized over ripen fruits of local *Lalith* of pink and *Sardar* or *Lucknow-49* of white flesh cultivars were collected from the Department of Horticulture and progressive farmers of the Rahuri, Nasik, Yeola Tahashils.

## Ingredients

Citric acid, salt, sugar and hydrogenated fat were obtained from market and used as ingredients for preparation of guava leather (Table 1).

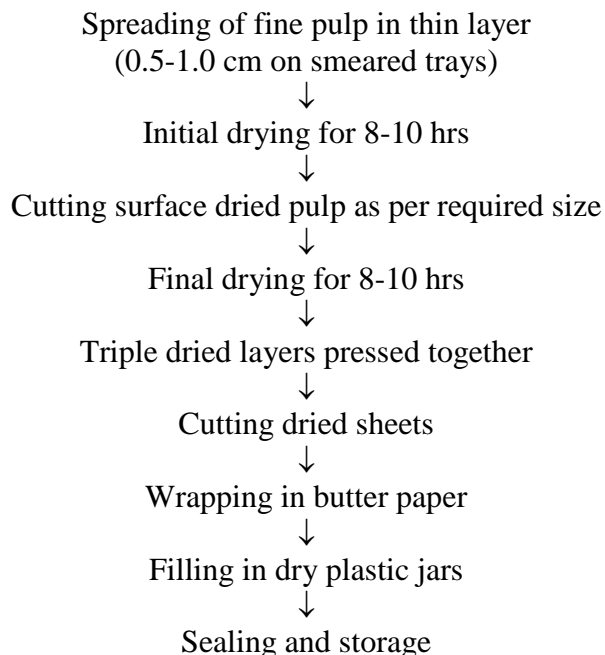
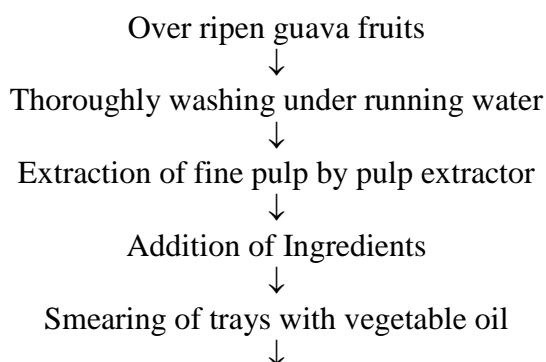
## Chemicals

Most of the chemicals used in this investigation were of analytical grade, obtained from M/s. British Drug House Mumbai, M/s. Sarabhai M. Chemicals, M/s. Baroda, S.D. Fine Chemical Ltd., Mumbai and E. Merck (India), Mumbai.

## Preparation of guava leathers

Fine guava fruit pulp was used for the preparation of fruit leather. In this pulp content ingredient like sugar, salt and citric acid as per the formula, which are further mixed well and then smeared with vegetable oil on the aluminum or stainless steel trays into thin layers (0.5 to 1.0 cm thick). Then the pulp was dried in hot air oven at 50 °C for 8-10 hrs. After that semi surface-dried pulp sheets were cut into desired size usually of rectangular and again dried for 8-10 hrs. After drying three layers of sheets were kept together and pressed properly to form one sheet. Then desired size (3 x 4 cm) cutting was done and dried under fan for 2-3 hrs and then wrapped into a metalized polyester wrapper and then kept in plastic bag for storage study.

## Flow sheet for preparation of guava leather



## Standardization of ingredient levels for guava leather

Preliminary experiments were conducted to select the optimum level of each ingredient like sugar, salt, citric acid. The optimum levels of ingredients were finalized by sensory evaluation of guava leather by a panel of minimum ten semi-trained judges using 9 points Hedonic scale (Amerine *et al.*, 1965).

## Packaging

The prepared leathers were packed in a butter paper stored at both ambient (25±2°C) and refrigerated (7±2°C) temperature safely in laboratory at the middle compartment of the refrigerator for 3 months storage study. Analysis of stored guava leathers was carried out at an interval of 0, 30, 60, 90 day's storage period.

## Physico-chemical analysis

The over ripen guava fruit pulp was analyzed for the moisture, TSS, titrable acidity, reducing sugars, total sugars, and vitamin C using standard methods of AOAC (2005).

## **Statistical analysis**

Results and experiments were planned and carried out using Factorial Completely Randomized Design (FCRD) using three to ten replications according to methods of the procedure given by Panse and Sukhatme (1967).

## **Results and Discussion**

### **Physio-chemical characteristics of Sardar guava fruit and pulp**

The physio-chemical composition of fruit plays a very important role in processing technology of guava as well as final quality of the product. The Physio-chemical composition of Sardar cultivar of guava is presented in Table 2. The over ripened fruits were round, yellowish in color. The average weight of fruit was 139 g/fruit. The average values for recovery of pulp and processing losses were 92.60 and 7.40 per cent, respectively.

### **Physio-chemical characteristics of Lalith guava fruit and its pulp**

Lalith fruits were attractive, saffron yellow with occasional red blush and medium sized with firm pink colored flesh. It has good blend of sugar and acid and suitable for both processing and table purpose. Its yield was more than 24 per cent than the Allahabad Safeda variety (Yadav, 2007). The over ripen fruits of Lalith were round, yellowish in color. The average weight of fruit was 126 g/fruit. The average values for recovery of pulp and processing losses were 91.0 and 9.0 per cent, respectively.

### **Recovery of pulp**

The recovery of pulp from Sardar guava variety was 92.60 %, while recovery of pulp for Lalith guava variety was 91.0 % (Table 6).

### **Organoleptic properties of pretreatment guava leathers**

From the organoleptic evaluation presented in Tables 3, 4 treatments T<sub>2</sub> and T<sub>5</sub> were selected as best among the 7 various treatments for both Sardar and Lalith guava leathers. Selected treatments T<sub>2</sub> and T<sub>5</sub> were renamed as V<sub>1</sub>T<sub>1</sub> and V<sub>1</sub>T<sub>2</sub> in Sardar guava leather, and for Lalith guava leather as V<sub>2</sub>T<sub>1</sub> and V<sub>2</sub>T<sub>2</sub>.

### **Organoleptic properties of fresh guava leathers (selected treatments)**

The selected treatments leather was prepared for further study. The organoleptic evaluations of fresh guava leather from both varieties are presented in Table 5. During organoleptic evaluation, V<sub>1</sub>T<sub>1</sub> and V<sub>2</sub>T<sub>1</sub> found similar and better than V<sub>1</sub>T<sub>2</sub> and V<sub>2</sub>T<sub>2</sub> for overall acceptability. So again T<sub>2</sub> and T<sub>5</sub> samples of guava leather (both varieties) are prepared and kept for storage of 3 months at both ambient and refrigerated conditions.

### **Yield and chemical properties of fresh guava leathers**

The yield and chemical properties of fresh guava leather of both Sardar as well as Lalith cultivars are shown in Table 6. The yield of guava leathers ranged from 617-625 g/kg of pulp. The yield of guava leather V<sub>1</sub>T<sub>1</sub> was slightly higher as compared to V<sub>1</sub>T<sub>2</sub>, V<sub>2</sub>T<sub>1</sub>, and V<sub>2</sub>T<sub>2</sub>. There was no much difference in yield between three treatments, as the levels of ingredients are same.

### **Changes in chemical composition of guava leathers during storage**

Guava leather prepared from selected treatments from both varieties was kept for storage study at ambient (27 ± 2°C) and refrigerator (7 ± 2°C) temperatures. The storage study results of guava leather are presented in Tables 9 to 12.

### **Chemical properties of guava leathers**

Chemical properties of guava leathers are mentioned in Table 6. There was slight variation in chemical properties which might be due to change in variety. Pink flesh guava leather has low amount of ascorbic content when compared to the sardar guava leather.

### **Changes on organoleptic properties of guava leathers during storage**

The freshly prepared guava leathers were evaluated organoleptically by a panel of semi trained judges on a 9 point Hedonic scale. The mean sensory scores of fresh and stored guava leather samples for parameters like color and appearance, texture, flavor, taste and overall acceptability of guava leather samples are presented in Tables 9-12.

### **Color and appearance**

The score for color and appearance in the present investigation of guava leather as influenced by storage temperature and period is presented in Tables 9-12. A gradual decrease in score from 8.35 to 7.45 at ambient temperature and from 8.35 to 7.80 at refrigerated temperature was observed for 90 days of storage. The score 8.35 was observed in  $V_1T_1$  guava leather sample stored at refrigerated condition. Similar trend for color and appearance of guava leathers was observed at ambient condition but the values were at lower level than the refrigerated storage. The color deterioration was more in guava leathers stored at ambient condition. This may be due to degradation of pigments that might have occurred at ambient temperature.

Similar observations were reported in sweet potato leather (Collins and Hutsell, 1987), jack fruit leather (Che Man and Taufik, 1995), fig and other fruit products (Doreyappa Gowda *et*

*al.*, 1995), mango fruit bar with respect to storage temperature (Doreyappa Gowda *et al.*, 1995), dried figs (Palve, 2002), guava-papaya fruit bar (Vennilla *et al.*, 2004), fig leather (Chandeswar *et al.*, 2004 and Kotlawar, 2008) and high protein tamarind leather (Kharche, 2012). The results obtained in the present investigation are in concurrent with the literature.

### **Flavor**

The results on flavor score of guava leather samples as influenced by storage are presented in Tables 9-12. A gradual decrease in score for flavor from 8.20 to 7.55 at ambient temperature and from 8.20 to 7.62 at refrigerated temperature was observed. The flavor retention was higher at refrigerated condition than the ambient condition. In both storage conditions treatment  $V_2T_1$  produced highest flavor score when stored at refrigerated condition. The flavoring compounds may be lost at higher rate at higher storage temperature (thus causing lower flavor score) at ambient condition than at refrigerated condition.

A gradual decrease in flavor score was reported with increase in storage period of guava leathers. Dried figs (Mali, 1997 and Chandeswar *et al.*, 2004), guava-Papaya fruit bar (Vennilla *et al.*, 2004), fig leather (Kotlawar, 2008) and high protein tamarind leather (Kharche, 2012). The results obtained in the present investigation are similar to earlier reports.

### **Texture**

The sensory results for texture score of guava leather samples are presented in Tables 9-12. A gradual decrease in texture score was observed in guava leathers from 8.27 to 7.56 at ambient temperature and from 8.27 to 7.80 at refrigerated temperature.

**Table.1** Treatment details for experimentation

Treatments	Pulp (%)	Sugar (%)	Salt (%)	Citric acid (%)
T <sub>1</sub>	100	500	5	2
T <sub>2</sub>	100	750	5	2
T <sub>3</sub>	100	1000	5	2
T <sub>4</sub>	100	750	5	4
T <sub>5</sub>	100	750	-	-
T <sub>6</sub>	100	750	5	-
T <sub>7</sub>	100	750	-	4

**Table.2** Physio-chemical characteristics of Sardar, Lalith guava fruits

S. No.	Parameters	Sardar (white flesh)	Lalith (Pink flesh)
<b>A. Physical parameters of fruits</b>			
1.	Shape	Round	Round
2.	Color	Yellow	Saffron yellow
3.	Average length (cm)	6.20	4.10
4.	Average fruit weight (g)	139.0	126
5.	Diameter (cm)	6.20	6.2
6.	Per cent of pulp recovery (%)	92.60	91.0
7.	Waste material/Seed content losses (%)	7.40	9.0
<b>B. Chemical constituents of Pulp</b>			
1.	TSS (° Brix)	9.20	9.10
2.	Acidity (%)	0.450	0.380
3.	Total sugars (%)	7.70	5.10
4.	Reducing sugars (%)	5.30	7.40
5.	Vitamin C (mg/100 g)	210	130
6.	Moisture (%)	82.56	83.60

**Table.3** Organoleptic evaluation of fresh Sardar variety guava leather<sup>a</sup>

S. No	Treatments	Color and appearance	Flavor	Taste	Texture	Overall acceptability	Selected for further study
1	V <sub>1</sub> T <sub>1</sub>	7.60	8.00	8.00	7.90	7.87	Not selected
2	V <sub>1</sub> T <sub>2</sub>	8.80	8.30	8.20	8.30	<b>8.40</b>	V <sub>1</sub> T <sub>1</sub> selected
3	V <sub>1</sub> T <sub>3</sub>	8.00	7.70	7.60	8.10	7.85	Not selected
4	V <sub>1</sub> T <sub>4</sub>	7.90	7.50	7.60	7.60	7.65	Not selected
5	V <sub>1</sub> T <sub>5</sub>	8.40	7.80	8.00	7.80	<b>8.00</b>	V <sub>1</sub> T <sub>2</sub> selected
6	V <sub>1</sub> T <sub>6</sub>	6.50	6.40	6.50	6.90	6.57	Not selected
7	V <sub>1</sub> T <sub>7</sub>	6.70	6.90	6.90	6.80	6.82	Not selected

Whereas, a = Ten replications with 9 point hedonic scale

V<sub>1</sub> = Sardar guava variety (white flesh)

**Table.4** Organoleptic evaluation of fresh Lalith variety guava leather<sup>a</sup>

S. No	Treatments	Color and appearance	Flavor	Taste	Texture	Overall acceptability	Selected for further study
1	V <sub>2</sub> T <sub>1</sub>	7.5	8.0	7.5	7.6	7.65	Not selected
2	V <sub>2</sub> T <sub>2</sub>	8.7	8.2	8.2	8.7	<b>8.45</b>	V <sub>2</sub> T <sub>1</sub> selected
3	V <sub>2</sub> T <sub>3</sub>	8.5	8.2	8.5	8.0	8.30	Not selected
4	V <sub>2</sub> T <sub>4</sub>	7.8	8.0	8.0	7.9	7.92	Not selected
5	V <sub>2</sub> T <sub>5</sub>	8.5	8.2	8.2	8.4	<b>8.33</b>	V <sub>2</sub> T <sub>2</sub> selected
6	V <sub>2</sub> T <sub>6</sub>	7.6	7.9	8.3	7.6	7.85	Not selected
7	V <sub>2</sub> T <sub>7</sub>	7.7	8.0	8.0	7.8	7.87	Not selected

Whereas,

a = Ten replications with 9 point hedonic scale

V<sub>2</sub> = Lalith guava variety (pink flesh)

**Table.5** Organoleptic properties of selected fresh guava leathers<sup>a</sup>

Treatments	Color and appearance	Flavor	Texture	Taste	Overall acceptability
V <sub>1</sub> T <sub>1</sub>	8.59	8.46	8.39	8.64	8.53
V <sub>1</sub> T <sub>2</sub>	8.14	8.03	8.14	8.12	8.07
V <sub>2</sub> T <sub>1</sub>	8.65	8.52	8.66	8.32	8.56
V <sub>2</sub> T <sub>2</sub>	8.05	7.80	7.90	8.13	8.37
SEM <sub>±</sub>	0.022	0.019	0.022	0.016	0.018
CD at 5 %	0.068	0.059	0.068	0.049	0.055

Whereas, a = Four replications.

V<sub>1</sub>: Sardar guava variety (white flesh), V<sub>2</sub>: Lalith guava variety (Pink flesh)

T<sub>1</sub>: 750 g sugar + 5 g salt + 2 g citric acid per kg guava pulp

T<sub>2</sub>: 750 g sugar per kg guava pulp

**Table.6** Yield and chemical properties of fresh guava leathers<sup>a</sup>

Treatments	Yield (g/kg Pulp)	Moisture (%)	TSS (° Brix)	Titration acidity (%)	Reducing sugars (%)	Total sugars (%)	Ascorbic acid (mg/100g)	Total cost
V <sub>1</sub> T <sub>1</sub>	625.76	15.29	76.10	0.541	14.32	68.72	125.28	135.55
V <sub>1</sub> T <sub>2</sub>	618.06	15.12	76.00	0.462	14.12	68.23	127.30	135.00
V <sub>2</sub> T <sub>1</sub>	624.00	16.75	75.85	0.490	14.19	68.47	71.81	155.55
V <sub>2</sub> T <sub>2</sub>	617.00	16.27	75.85	0.412	12.92	68.28	73.34	155.00
SEM <sub>±</sub>	1.711	0.024	0.036	0.0011	0.014	0.010	0.127	-
CD at 5 %	NS	0.073	NS	NS	0.045	0.032	NS	-

Whereas, a = Four replications.

V<sub>1</sub>: Sardar guava variety (white flesh), V<sub>2</sub>: Lalith guava variety (Pink flesh)

T<sub>1</sub>: 750 g sugar + 5 g salt + 2 g citric acid per kg guava pulp

T<sub>2</sub>: 750 g sugar per kg guava pulp.

**Table.8** Texture analysis of guava leathers

Treatments	Colour and appearance	Flavour	Texture	Taste	Overall acceptability
<b>Variety</b>					
V <sub>1</sub>	8.36	8.24	8.27	8.38	8.30
V <sub>2</sub>	8.35	8.16	8.28	8.22	8.46
SEm(±)	0.015	0.013	0.015	0.011	0.012
CD @ 5%	NS	0.041	NS	0.035	0.039
<b>Treatments</b>					
T <sub>1</sub>	8.62	8.49	8.52	8.48	8.54
T <sub>2</sub>	8.09	7.92	8.02	8.13	8.22
SEm(±)	0.015	0.013	0.015	0.011	0.012
CD @ 5%	0.048	0.041	0.048	0.035	0.039
<b>Two factor interaction</b>					
V <sub>1</sub> T <sub>1</sub>	8.59	8.46	8.39	8.64	8.53
V <sub>1</sub> T <sub>2</sub>	8.14	8.03	8.14	8.12	8.07
V <sub>2</sub> T <sub>1</sub>	8.65	8.52	8.66	8.32	8.56
V <sub>2</sub> T <sub>2</sub>	8.05	7.80	7.90	8.13	8.37
SEm(±)	0.022	0.019	0.022	0.016	0.018
CD @ 5%	0.068	0.050	0.068	0.049	0.055

Whereas,

AT= Ambient temperature, RT= Refrigerated temperature

V<sub>1</sub>: Sardar guava variety (white flesh), V<sub>2</sub>: Lalith guava variety (Pink flesh)

T<sub>1</sub>: 750 g sugar + 5 g salt + 2 g citric acid per kg guava pulp

T<sub>2</sub>: 750 g sugar per kg guava pulp.



**Table.9** Effect of storage period on organoleptic properties of fresh guava leathers at 0 days storage

Treatments	Colour and appearance	Flavour	Texture	Taste	Overall acceptability
<b>Variety</b>					
V <sub>1</sub>	8.36	8.24	8.27	8.38	8.30
V <sub>2</sub>	8.35	8.16	8.28	8.22	8.46
SEm(±)	0.015	0.013	0.015	0.011	0.012
CD @ 5%	NS	0.041	NS	0.035	0.039
<b>Treatments</b>					
T <sub>1</sub>	8.62	8.49	8.52	8.48	8.54
T <sub>2</sub>	8.09	7.92	8.02	8.13	8.22
SEm(±)	0.015	0.013	0.015	0.011	0.012
CD @ 5%	0.048	0.041	0.048	0.035	0.039
<b>Two factor interaction</b>					
V <sub>1</sub> T <sub>1</sub>	8.59	8.46	8.39	8.64	8.53
V <sub>1</sub> T <sub>2</sub>	8.14	8.03	8.14	8.12	8.07
V <sub>2</sub> T <sub>1</sub>	8.65	8.52	8.66	8.32	8.56
V <sub>2</sub> T <sub>2</sub>	8.05	7.80	7.90	8.13	8.37
SEm(±)	0.022	0.019	0.022	0.016	0.018
CD @ 5%	0.068	0.050	0.068	0.049	0.055

A=Ambient (25±2 °C), R=Refrigerated (5±2 °C)

V<sub>1</sub>: Sardar guava variety (white flesh), V<sub>2</sub>: Lalith guava variety (Pink flesh).

T<sub>1</sub>: 750g sugar + 5g salt + 2g citric acid per kg guava pulp, T<sub>2</sub>: 750g sugar per kg guava pulp.

**Table.10** Effect of storage period on organoleptic properties of guava leather at 30 days storage

Treatments	Colour and appearance		Flavour		Texture		Taste		Overall acceptability	
	A	R	A	R	A	R	A	R	A	R
<b>Variety</b>										
V <sub>1</sub>	7.89	8.20	7.75	7.90	7.93	8.02	8.00	8.22	7.89	8.03
V <sub>2</sub>	7.93	7.93	7.79	7.97	7.86	8.08	8.10	8.18	8.11	8.23
SEm(±)	0.012	0.015	0.019	0.018	0.015	0.010	0.019	0.020	0.016	0.016
CD @ 5%	0.038	0.048	NS	0.058	0.047	0.030	0.061	NS	0.049	0.050
<b>Treatments</b>										
T <sub>1</sub>	8.18	8.41	8.05	8.19	8.03	8.23	8.28	8.43	8.14	8.33
T <sub>2</sub>	7.64	7.72	7.48	7.67	7.76	7.87	7.81	7.97	7.86	7.93
SEm(±)	0.012	0.015	0.019	0.018	0.015	0.010	0.019	0.020	0.016	0.016
CD @ 5%	0.038	0.048	0.060	0.058	0.047	0.030	0.061	0.063	0.049	0.050
<b>Two factor interaction</b>										
V <sub>1</sub> T <sub>1</sub>	8.12	8.56	7.97	8.08	8.04	8.12	8.45	8.61	8.13	8.33
V <sub>1</sub> T <sub>2</sub>	7.66	7.83	7.53	7.71	7.82	7.92	7.54	7.82	7.66	7.73
V <sub>2</sub> T <sub>1</sub>	8.24	8.25	8.14	8.30	8.02	8.34	8.12	8.25	8.16	8.34
V <sub>2</sub> T <sub>2</sub>	7.62	7.62	7.44	7.63	7.70	7.82	8.08	8.12	8.06	8.12
SEm(±)	0.017	0.023	0.027	0.026	0.021	0.014	0.028	0.029	0.022	0.023
CD @ 5%	0.054	0.066	0.085	0.082	0.066	0.043	0.086	0.089	0.070	0.071

A=Ambient (25±2 °C), R=Refrigerated (5±2 °C)

V<sub>1</sub>: Sardar guava variety (white flesh), V<sub>2</sub>: Lalith guava variety (Pink flesh).

T<sub>1</sub>: 750g sugar + 5g salt + 2g citric acid per kg guava pulp, T<sub>2</sub>: 750g sugar per kg guava pulp.

**Table.11** Effect of storage period on organoleptic properties of guava leather at 60 days storage

Treatments	Colour and appearance		Flavour		Texture		Taste		Overall acceptability	
	A	R	A	R	A	R	A	R	A	R
<b>Variety</b>										
V <sub>1</sub>	7.66	8.06	7.22	7.43	7.72	7.90	7.68	8.13	7.59	7.97
V <sub>2</sub>	7.78	7.76	7.59	7.73	7.59	7.83	7.95	8.18	7.82	8.06
<b>SEm(±)</b>	0.012	0.014	0.021	0.011	0.008	0.011	0.014	0.011	0.013	0.009
<b>CD @ 5%</b>	0.038	0.045	0.066	0.035	0.025	0.035	0.044	0.036	0.041	0.029
<b>Treatments</b>										
T <sub>1</sub>	8.06	8.22	7.63	7.78	7.80	8.00	8.05	8.43	7.87	8.25
T <sub>2</sub>	7.38	7.60	7.19	7.39	7.51	7.73	7.58	7.88	7.55	7.79
<b>SEm(±)</b>	0.012	0.014	0.021	0.011	0.008	0.011	0.014	0.011	0.013	0.009
<b>CD @ 5%</b>	0.038	0.045	0.066	0.035	0.025	0.035	0.044	0.036	0.041	0.029
<b>Two factor interaction</b>										
V <sub>1</sub> T <sub>1</sub>	8.00	8.33	7.39	7.62	7.82	7.98	8.02	8.63	7.84	8.40
V <sub>1</sub> T <sub>2</sub>	7.32	7.78	7.05	7.24	7.63	7.83	7.35	7.64	7.35	7.55
V <sub>2</sub> T <sub>1</sub>	8.12	8.11	7.86	7.94	7.79	8.03	8.08	8.24	7.90	8.10
V <sub>2</sub> T <sub>2</sub>	7.44	7.42	7.32	7.53	7.39	7.64	7.81	8.12	7.75	8.02
<b>SEm(±)</b>	0.017	0.021	0.030	0.016	0.011	0.016	0.020	0.016	0.019	0.013
<b>CD @ 5%</b>	NS	0.064	0.094	NS	0.035	0.049	0.063	0.051	0.059	0.041

A=Ambient (25±2 °C), R=Refrigerated (5±2 °C)

V<sub>1</sub>: Sardar guava variety (white flesh), V<sub>2</sub>: Lalith guava variety (Pink flesh).

T<sub>1</sub>: 750g sugar + 5g salt + 2g citric acid per kg guava pulp, T<sub>2</sub>: 750g sugar per kg guava pulp

**Table.12** Effect of storage period on organoleptic properties of guava leather at 90 days storage

Treatments	Colour and appearance		Flavour		Texture		Taste		Overall acceptability	
	A	R	A	R	A	R	A	R	A	R
<b>Variety</b>										
V <sub>1</sub>	7.33	7.72	7.24	7.43	7.40	7.64	7.52	8.13	7.40	7.73
V <sub>2</sub>	7.58	7.87	7.87	7.82	7.72	7.97	7.47	7.83	7.67	7.83
<b>SEm(±)</b>	0.012	0.009	0.013	0.011	0.012	0.019	0.009	0.012	0.014	0.014
<b>CD @ 5%</b>	0.039	0.030	0.041	0.035	0.038	0.059	0.027	0.038	0.043	0.044
<b>Treatments</b>										
T <sub>1</sub>	7.68	8.02	7.73	7.78	7.65	7.99	7.71	8.28	7.72	8.00
T <sub>2</sub>	7.23	7.57	7.39	7.47	7.47	7.62	7.28	7.68	7.35	7.56
<b>SEm(±)</b>	0.012	0.009	0.013	0.011	0.012	0.019	0.009	0.012	0.014	0.014
<b>CD @ 5%</b>	0.039	0.030	0.041	0.035	0.038	0.059	0.027	0.038	0.043	0.044
<b>Two factor interaction</b>										
V <sub>1</sub> T <sub>1</sub>	7.64	8.03	7.43	7.62	7.47	7.74	7.90	8.63	7.66	7.98
V <sub>1</sub> T <sub>2</sub>	7.03	7.42	7.06	7.24	7.34	7.53	7.14	7.64	7.13	7.47
V <sub>2</sub> T <sub>1</sub>	7.72	8.02	8.02	7.94	7.84	8.23	7.52	7.92	7.78	8.02
V <sub>2</sub> T <sub>2</sub>	7.44	7.73	7.72	7.70	7.60	7.70	7.42	7.73	7.56	7.65
<b>SEm(±)</b>	0.018	0.013	0.019	0.016	0.017	0.027	0.012	0.017	0.020	0.020
<b>CD @ 5%</b>	0.055	0.042	NS	0.049	0.054	0.083	0.039	0.054	0.062	0.062

A=Ambient (25±2 °C), R=Refrigerated (5±2 °C)

V<sub>1</sub>: Sardar guava variety (white flesh), V<sub>2</sub>: Lalith guava variety (Pink flesh).

T<sub>1</sub>: 750g sugar + 5g salt + 2g citric acid per kg guava pulp, T<sub>2</sub>: 750g sugar per kg guava pulp

**Plate.1** Sardar guava leather at 0 days storage



**Plate.2** Lalith guava leather at 0 days storage



1-2, Ambient temperature ( $27 \pm 2$  °C)  
3-4, Refrigerated temperature ( $7 \pm 2$  °C)

The maximum score 8.27 was observed in  $V_2T_1$  sample stored at refrigerated temperature.

The score for texture decreased significantly during storage at ambient temperature than stored at refrigerated temperature. A gradual

decrease in texture score is due to hardening effect resulting from loss of moisture during storage.

Similar results were obtained in various experiments performed earlier on sweet potato leather (Collins and Hutsell, 1987),

jack fruit leather (Che Man and Taufik, 1995), fig and other fruit products (Doreyappa Gowda *et al.*, 1995). Guava –papaya fruit bar (Vennilla *et al.*, 2004), fig leather (Kotlawar, 2008) and high protein tamarind leather (Kharche, 2012). The results obtained in the present investigation for guava leathers are in agreement with literature.

### **Taste**

The results on taste score of guava leather samples are presented in Tables 9-12. A gradual decrease in score for taste of guava leathers from 8.30 to 7.49 at ambient temperature and from 8.30 to 7.98 at refrigerated temperature was observed.

The taste deterioration was more in guava leathers at ambient condition than at refrigerated temperature. The guava leather samples of V<sub>2</sub>T<sub>1</sub> at refrigerated temperature gave maximum taste score 8.60 in comparison with other treatments. This might be due to proper blending of sugar and acidity as well as consistency of the guava leather. Both conditions of storage for guava leather samples gave acceptable taste score.

It is reported that the taste score decreased during storage with respect to storage condition and period of storage., in sweet potato leather (Collins and Hutsell, 1987), jack fruit leather (Che Man and Taufik, 1995), guava –papaya fruit bar (Vennilla *et al.*, 2004) and fig leather (Kotlawar, 2008).

The results obtained in the present investigation for taste score in guava leathers are in agreement with literature.

### **Overall acceptability**

The results on overall acceptability score of guava leathers influenced by storage condition and period with respect to various

treatments are presented in Tables 9-12. A gradual decrease in overall acceptability score from 8.38 to 7.53 at ambient temperature and from 8.38 to 7.78 at refrigerated temperature. It was observed that decrease in overall acceptability score at ambient temperature was faster than at refrigerated temperature.

The maximum score of 8.00 was observed in treatment V<sub>2</sub>T<sub>1</sub> stored at refrigerated temperature.

The highest overall acceptability score was observed in guava leathers stored at refrigerated temperature than at ambient temperature. It may be due to faster deterioration in terms of color, flavor, texture and taste at higher temperature during ambient condition. It is reported that the overall acceptability score decrease during storage with respect to the storage condition and period.

Previous researchers have shown that the decrease in overall acceptability in case of papaya leather (Harvey and Cavaletto, 1978), mango fruit bar (Doreyappa Gowda *et al.*, 1994), jack fruit leathers (Che Man and Taufik, 1995), guava-papaya fruit bar (Vennilla *et al.*, 2004) and mango leather (Gill *et al.*, 2004).

### **Texture analysis of guava leathers**

The Texture analysis of guava leathers was done at initial 0 days storage and final after 90 days storage by using the available Shimadzu Texturometer. The force in (N) used to break down the individual leather is recorded separately. The results obtained are presented in Table 8. Results obtained stated that more force was used to break the fresh leather and less force was used after 90 days storage. It may be all due to increase in crystallization of sugar within increase in storage period.

### **Economics for making guava leathers**

The results on production cost of guava leathers are presented in Table 6. The cost of production of 1 kg guava (white flesh) leather of treatment T<sub>1</sub> was Rs.135.55 and for treatment T<sub>2</sub> Rs.135.00 only.

Whereas, the cost of production of 1 kg guava (pink flesh) leather was of treatment T<sub>1</sub> was Rs.155.55 and for treatment T<sub>2</sub> Rs.155.00 only. These costs did not include rent, transport charges, sale commission, local taxes etc. However, there was no significant difference in cost of guava leathers making among the treatments. The costs are for laboratory (small scale) preparation of guava leathers. These may be still reduced during mechanization of the process for mass production.

From the results of this research it was concluded that in physicochemical analysis, guava leather prepared with treatment T<sub>1</sub> (750g sugar + 5g salt + 2g citric acid per kg guava pulp) showed better organoleptic properties as well as good storage stability at both storage (ambient and refrigerated) conditions up to 3 months storage period. Microbial results also stated that product was safe to consume even after 3 months at both storage temperatures

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