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Standardization of recipes on organoleptic evaluation of guava leather

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Abstract
An investigation was carried out to assess the nutritive and organoleptic characteristics of guava leather by using different levels of sugar (20%, 40%, 60% & 80%) with constant guava pulp (100%) and citric acid (0.2%, 0.4% & 0.6%). Preliminary experiments were conducted to find out the optimum levels of sugar and citric acid with guava pulp (constant) for preparation of quality guava leather. The mean score of organoleptic characters were recorded on 9 point hedonic scale in guava leather. The prepared guava leather was stored at ambient temperature (25 ± 2 °C) for 100 days and evaluation for fresh as well as stored samples was done at an interval of 0, 20, 40, 60, 80 and 100 days to study their storage feasibility. The guava pulp (constant) + 60% sugar + 0.2% citric acid in treatment T7 (G3C1) secured the highest sensory score viz., colour (8.80), texture (8.86), taste (8.96) and overall acceptability (8.96) with better flavour (7.83).
The storage studies indicate that there was a gradual decrease in colour, flavour, texture, taste, overall acceptability with advancement of storage period. The sensory quality of guava leather decreased at faster rate during storage. However it was found to be acceptable in good condition even after 100 days of storage at ambient temperature.

Keywords: Guava, leather, sensory score, citric acid, sugar, organoleptic

Introduction
Guava (*Psidium guajava* L.) is one of the dominant fruit crop of tropical and sub-tropical regions of India, which belongs to family myrtaceae. It has been popularly known as "Poor man's apple" because of its plenty availability to every person at a very low price.
At present, it is the fifth most important fruit crop in India after mango, banana, citrus and papaya with annual production of 4.05 million tonnes from 0.26 million hectare area accounting about 4.1% and 4.2% of total production and area respectively. The most important guava growing states are Madhya Pradesh, Bihar, Uttar Pradesh, Haryana, Gujarat, Maharashtra, Andhra Pradesh and Rajasthan. Madhya Pradesh is the leading guava producing state (16.9%) with 35.1 thousand hectare area 686.7 thousand million tonnes production and 19.6 MT/ha productivity (Anonymous, 2017) [3].
Guava is a fruit with excellent digestive and nutritive value, pleasant sour-sweet taste, high palatability and availability in abundance at moderate price. The fruit contains ascorbic acid (260 mg/100gm.), pectin (1.15%), minerals like phosphorous, calcium etc. In recent years, guava is getting popularity in the international trade due to its nutritional value and processed products. Fresh fruit has limited shelf life. Therefore, it is necessary to utilize this fruit for making different products to increase its availability over an extended period stabilize the price during glut season. Excellent salad, pudding, jam, jelly, cheese, canned fruit, RTS, nectar, squash, ice-cream and toffees can be made from guava fruit (Jain and Asati 2004) [10].
There has been grate increase in the production rate of these fruits over the years, and this may be due to their increased consumption pattern in the tropics. It is common experience that 20-25% of the fruit is completely damaged and spoiled before it reaches the consumer. 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.

2. Materials and Methods

The experiment was carried out carried out in the Post-Harvest Laboratory, Department of Horticulture, and College of Agriculture JNKVV Jabalpur (M.P.) in the year 2016 - 2017. For assessing the chemical qualities of stored guava leather sample were analyzed at an interval of 20 days from 0 to 100 days. The various recipes used for preparation of leather were arranged in a factorial completely randomized design replicated thrice. The guava leather consists of two factors (Factor A and Factor B) in which Factor A consisted of 4 levels and Factor B consisted of 3 levels, respectively in both products in three replications and then recorded data were analyzed accordingly.

S. No.	Factor B (Citric acid level)	Notation
1.	0.2%	C1
2.	0.4%	C2
3.	0.6%	C3

S. No.	Factor A (Pulp and Sugar ratio)	Notation
1.	100% Guava pulp + 20% Sugar	G1
2.	100% Guava pulp + 40% Sugar	G2
3.	100% Guava pulp + 60% Sugar	G3
4.	100% Guava pulp + 80% Sugar	G4

The fully mature uniformly ripe, disease free, fresh guava fruits were selected for the preparation of pulp. The fruits were washed in running tap water for removing the adhering dirt. After washing of fruits, preliminary trial was conducted to standardize the method of extraction of pulp. The pulp was extracted out using the following procedure. The fruits were cut into small pieces with the help of stainless steel knife. Small pieces of guava then grind in a mixer for 5-10 min for making pulp. The seeds were separated from pulp with the help of stainless steel sieve. Potassium meta bisulphate was added to pulp and mixed thoroughly before filling it in sterilized glass jars.

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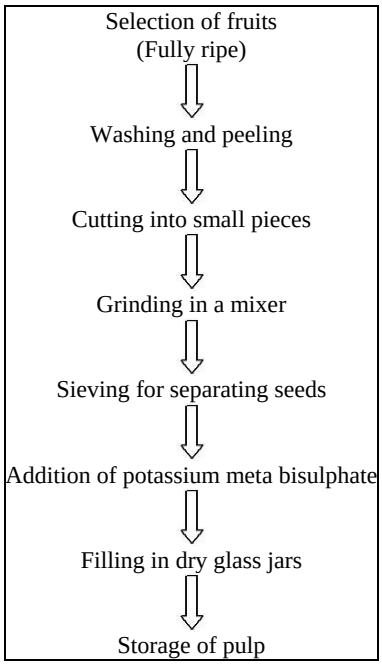


Flow chart for extraction of guava pulp

Preparation of guava leather

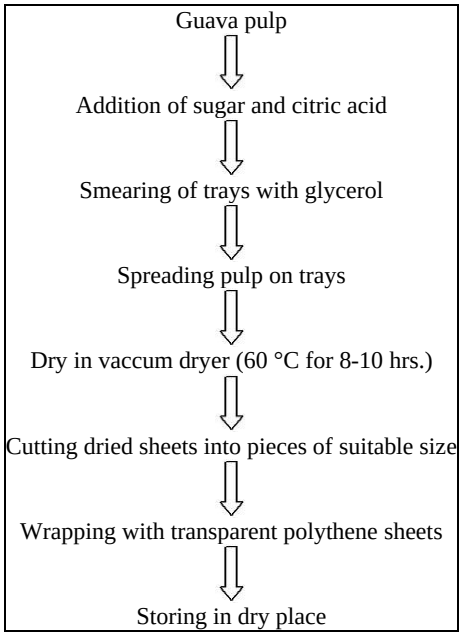
The leather was prepared by guava pulp according to different recipe. Mix all the ingredients then allow cooking for 15-20 minutes with continuous stirring. Then further detailed description of preparation of leather is as follows

Spreading on polythene sheets

Polythene sheet was cut according to size of trays and greased with glycerol. Then mixture of fruit pulp was poured into trays of 0.5-1.0cm thick layer. After that, trays placed into vacuum dryer at 60°C for 8-10 hrs.

Packaging and Storage

Dried leather was cut into uniform pieces of 3x4cm size and wrapped with polythene sheets. The leather was stored at room temperature.



Flow chart for preparation of Guava Leather

The organoleptic character (i.e. colour, flavour, texture, taste and overall acceptability) of guava leather were recorded for each variety and recipe. For evaluation of various organoleptic quality attributes, the method discussed by Amerine *et al.* (1965) [2] was adopted using a nine-point hedonic scale basis (1 = dislike extremely and 9 = like extremely). Thickness of the leather was measured with the help of micrometer before and after drying of leather.

3. Result and Discussion

The present investigation entitled "Standardization of recipes on organoleptic evaluation of guava leather" was carried out to observe the effect of different blend ratio of guava and sugar along with citric acid etc. on preparation of guava leather and to find out acceptability of the products during storage.

3.1 Colour

The data presented in Table 1 clearly indicated that all treatments have slight differences in colour during storage of 100 days, colour rating value of guava leather diminished gradually with increase in storage. Decrease in colour of stored guava leather may be due to emphatic browning during storage. The changes probably occurred due to browning reactions, that proceeds oxidative (non enzymatic vitamin C oxidation and enzymatic oxidation of polyphenols) and enzymatically controlled processes and caramelization of sugar. More the percentage of sugar more would be the caramelization with higher darkness of the leathers. Similar findings were obtained by Jadhavar *et al.* (2014) [9] in papaya fruit bar. Similarly, Mukisa *et al.* (2010) [12] in jack fruit leather and Aruna *et al.* (1999) [4] reported that higher deterioration in colour, appearance and texture on 6 and 9 months storage was observed at higher temperature in papaya fruit bar. Similarly, Baramanray *et al.* (1995) [5] reported that colour of guava nectar deteriorated with increase in storage time. Similar results were also found by Abdul *et al.* (1990) [1] in chiku leather and Cheman and Taufik (1995) [6] in jack fruit leather. Prasad and Mali (2006) [14] reported that in ber jam original colour disappeared at ambient temperature after 3 months of storage. The difference in colour of guava leather may be due to degradation of pigments and different ratio of sugar. Colour of guava leather is due to the presence of carotenoids (anthocyanin) in guava up to 100 days. Highest colour rating value 8.80 was observed for guava leather with G3 (100% guava + 60% sugar), respectively.

3.2 Flavour

The aroma results from volatile substances such as esters, ketones, terpences, aldehydes and others. The loss of these volatiles leads to a decrease in aroma detection. The mean panelist score for flavour profile of guava leather under storage indicated a decreasing trend with increase in sugar quantity. It was also clear from the data presented in Table 2 that the higher guava percentage imparted more flavour to guava leather therefore the highest value obtained 8.90 was observed for guava leather with G1 (100% guava + 20% sugar). Similar results were found by Jain and Nema (2007) [11] in guava leather. A decreasing pattern of flavour rating value observed during storage of products for 100 days. The result was in conformity with Baramanray *et al.* (1995) [5] as they reported that organoleptic quality like colour, flavour and taste of guava nectar deteriorated with increase in storage time. Cherian and Cherian (2003) [7] also reported a little downfall in each sensory parameter in case of blended papaya leather.

3.3 Texture

The highest value 8.86 for texture was found in G3 (100% guava + 60% sugar), while minimum 7.36 in G4 (100% guava + 80% sugar), shown in Table 3. The leather had low sugar, so leather became hard and had more chewiness. Whereas, due to higher sugar content of leather texture was viscous and had less chewiness. Therefore, the optimum sugar (60%) in this study added to leather proved be the best rated and texture of leather was also found excellent. Similar findings were obtained by Jain and Nema (2007) [11] in guava leather as they reported that low concentration of sugar results in hardness and higher concentration results in viscous and less chewiness of leather, therefore optimum level of sugar is suitable for leather. As storage period increases, a very slight change in texture of leather was observed. This might be due to reduction of moisture at the time of storage. Similar result was reported by Aruna *et al.* (1999) [2] during storage papaya fruit bar. Harsimrat and Dhawan (2001) [8] reported a significant reduction in organoleptic rating in guava fruit bar.

3.4 Taste

The taste attributes scores presented in Table 4 clearly indicated that G3 (100% guava + 60% sugar) combination was preferred most by judges in case of guava leather. An increase in the quantity of sugar in leather also reduces the taste rating. This is due to higher TSS value. Similar results were found by Jain and Nema (2007) [10] with guava leather, Naikare *et al.* (1998) [12]. Harsimarat and Dhawan (1998) [8] also reported that fruit bar of Allahabad Safeda as superior followed by Lucknow-49. During storage, a significant reduction in taste of guava leather was observed. This result was in conformity with Baramanray *et al.* (1995) [5] who found that taste reduced significantly with increased storage period. These results are also in agreement with Harsimrat and Dhawan (2001) [8] with guava bar and Relekar *et al.* (2011) [15] with value added products of sapota.

Table 1: Effect of different recipes on colour of guava leather during storage

Ratio of fruit pulp+sugar (Factor A)	0 days				20 days				40 days				60 days				80 days				100 days			
	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean
	C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3	
G1	8.0	7.9	7.8	7.90	7.7	7.7	7.6	7.68	7.6	7.5	7.4	7.50	7.4	7.2	7.1	7.23	7.2	7.0	6.9	7.03	7.0	6.9	6.7	6.83
G2	8.8	8.6	8.4	8.60	8.6	8.4	8.2	8.40	8.4	8.1	7.9	8.13	8.3	7.9	7.7	7.96	8.1	7.7	7.5	7.76	7.9	7.5	7.4	7.46
G3	9.0	8.8	8.6	8.80	8.8	8.6	8.5	8.63	8.6	8.4	8.3	8.43	8.5	8.3	8.1	8.30	8.4	8.1	7.9	8.13	8.2	8.0	7.7	7.96
G4	7.6	7.4	7.2	7.40	7.4	7.3	7.0	7.23	7.2	7.1	6.9	7.06	7.0	6.8	6.6	6.80	6.9	6.7	6.5	6.70	6.7	6.5	6.3	6.66
MEAN	8.35	8.17	8.00		8.14	8.00	7.82		7.95	7.77	7.62		7.80	7.55	7.37		7.65	7.37	7.20		7.27	7.30	7.35	
Factor	A	B	AB		A	B	AB		A	B	AB		A	B	AB		A	B	AB		A	B	AB	
SEm±	0.065	0.057	0.113		0.067	0.058	0.116		0.067	0.058	0.117		0.069	0.060	0.119		0.062	0.053	0.107		0.059	0.051	0.103	
CD at 5% level	0.192	0.166	NS		0.196	0.170	NS		0.198	0.171	NS		0.202	0.175	NS		0.181	0.157	NS		0.174	0.151	NS	

Table 2: Effect of different recipes on flavour of guava leather during storage

Ratio of fruit pulp+sugar (Factor A)	0 days				20 days				40 days				60 days				80 days				100 days			
	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean
	C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3	
G1	9.0	8.9	8.8	8.90	8.9	8.8	8.7	8.80	8.8	8.7	8.7	8.73	8.5	8.3	8.30	8.36	8.2	8.0	8.0	8.06	7.8	7.6	7.4	7.60
G2	8.6	8.5	8.5	8.53	8.5	8.4	8.4	8.43	8.5	8.3	8.3	8.36	8.2	8.0	8.06	8.08	7.8	7.6	7.6	7.66	7.4	7.2	7.2	7.26
G3	8.0	7.8	7.7	7.83	7.8	7.6	7.6	7.66	7.6	7.4	7.4	7.46	7.2	7.0	7.06	7.08	7.0	6.7	6.8	6.83	6.7	6.6	6.6	6.46
G4	7.5	7.4	7.3	7.40	7.4	7.3	7.2	7.30	7.7	7.2	7.0	7.15	7.0	6.9	6.70	6.86	6.8	6.6	6.5	6.63	6.5	6.3	6.1	6.30
MEAN	8.27	8.15	8.07		8.15	8.02	7.97		8.02	7.90	7.86		7.72	7.55	7.53		7.45	7.22	7.22		7.07	6.87	6.77	
Factor	A	B	AB		A	B	AB		A	B	AB		A	B	AB		A	B	AB		A	B	AB	
SEm±	0.054	0.047	0.094		0.055	0.048	0.096		0.047	0.041	0.082		0.050	0.043	0.086		0.047	0.041	0.082		0.055	0.048	0.096	
CD at 5% level	0.160	0.138	NS		0.162	0.141	NS		0.138	0.120	NS		0.146	0.126	NS		0.138	0.120	NS		0.162	0.141	NS	

Table 3: Effect of different recipes on texture of guava leather during storage

Ratio of fruit pulp+sugar (Factor A)	0 days				20 days				40 days				60 days				80 days				100 days			
	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean
	C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3	
G1	8.2	8.0	8.0	8.06	8.0	7.8	7.8	7.86	7.6	7.5	7.4	7.50	7.4	7.2	7.1	7.23	7.0	6.9	6.8	6.91	6.8	6.7	6.5	6.66
G2	8.6	8.6	8.4	8.53	8.4	8.4	8.2	8.33	8.2	8.1	8.0	8.10	8.0	7.8	7.7	7.83	7.6	7.5	7.3	7.46	7.2	7.1	6.9	7.06
G3	8.9	8.8	8.8	8.86	8.8	8.6	8.5	8.65	8.6	8.5	8.4	8.50	8.4	8.2	8.2	8.26	8.0	7.8	7.8	7.86	7.6	7.4	7.3	7.43
G4	7.5	7.4	7.2	7.36	7.2	7.2	7.0	7.13	7.0	7.0	6.8	6.93	6.9	6.8	6.6	6.76	6.7	6.7	6.5	6.63	6.4	6.4	6.2	6.33
MEAN	8.32	8.20	8.10		8.10	8.00	7.89		7.85	7.77	7.65		7.60	7.50	7.40		7.32	7.22	7.10		7.00	6.90	6.72	
Factor	A	B	AB		A	B	AB		A	B	AB		A	B	AB		A	B	AB		A	B	AB	
SEm±	0.047	0.041	0.082		0.053	0.046	0.092		0.057	0.049	0.099		0.053	0.046	0.091		0.062	0.054	0.107		0.055	0.048	0.096	
CD at 5% level	0.138	0.120	NS		0.156	0.135	NS		0.167	0.145	NS		0.155	0.134	NS		0.182	0.157	NS		0.162	0.141	NS	

Table 4: Effect of different recipes on taste of guava leather during storage

Ratio of fruit pulp+sugar (Factor A)	0 days				20 days				40 days				60 days				80 days				100 days			
	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean	Citric acid (Factor B)			Mean
	C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3		C1	C2	C3	
G1	8.4	8.3	8.2	8.30	8.3	8.2	8.1	8.21	8.2	8.0	7.9	8.04	8.0	7.9	7.8	7.90	7.8	7.7	7.6	7.70	7.6	7.5	7.4	7.50
G2	8.7	8.6	8.5	8.60	8.6	8.6	8.5	8.56	8.5	8.4	8.4	8.43	8.4	8.2	8.2	8.26	8.3	8.2	8.1	8.20	8.1	8.0	7.9	8.00
G3	9.0	9.0	8.9	8.96	8.9	8.9	8.8	8.86	8.8	8.8	8.7	8.76	8.7	8.6	8.5	8.60	8.6	8.5	8.4	8.50	8.4	8.3	8.2	8.30
G4	8.3	8.1	8.0	8.13	8.2	8.0	7.9	8.03	8.0	7.900	7.8	7.90	7.8	7.7	7.6	7.70	7.6	7.5	7.4	7.50	7.4	7.3	7.2	7.30
MEAN	8.60	8.50	8.40		8.50	8.42	8.33		8.37	8.27	8.20		8.22	8.10	8.02		8.07	7.97	7.87		7.87	7.77	7.67	
Factor	A	B	AB		A	B	AB		A	B	AB		A	B	AB		A	B	AB		A	B	AB	
SEm±	0.060	0.052	0.104		0.048	0.042	0.084		0.051	0.044	0.089		0.059	0.051	0.103		0.055	0.048	0.076		0.053	0.046	0.091	
CD at 5% level	0.176	0.153	NS		0.142	0.123	NS		0.150	0.130	NS		0.174	0.151	NS		0.162	0.141	NS		0.155	0.134	NS	

Table 5: Effect of different recipes on overall acceptability of guava leather during storage

Ratio of fruit pulp+ sugar (Factor A)	0 days				20 days				40 days				60 days				80 days				100 days			
	Citric acid (Factor B)				Citric acid (Factor B)				Citric acid (Factor B)				Citric acid (Factor B)				Citric acid (Factor B)				Citric acid (Factor B)			
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean
G1	8.6	8.4	8.3	8.43	8.4	8.2	8.2	8.26	8.2	8.1	8.0	8.10	7.9	7.8	7.6	7.76	7.6	7.5	7.3	7.46	7.4	7.2	6.9	7.16
G2	8.8	8.7	8.6	8.66	8.6	8.5	8.4	8.50	8.4	8.2	8.2	8.26	8.1	8.0	8.0	8.03	7.9	7.7	7.6	7.73	7.6	7.5	7.3	7.46
G3	9.0	8.9	8.9	8.96	8.9	8.9	8.7	8.86	8.7	8.7	8.5	8.63	8.5	8.4	8.2	8.33	8.3	8.2	8.0	8.16	8.0	7.8	7.7	7.83
G4	7.8	7.8	7.6	7.73	7.5	7.4	7.2	7.36	7.0	7.0	6.8	6.93	6.8	6.8	6.5	6.70	6.6	6.5	6.2	6.43	6.4	6.3	6.0	6.23
MEAN	8.55	8.45	8.35		8.35	8.25	8.15		8.07	8.00	7.87		7.80	7.75	7.57		7.60	7.47	7.27		7.350	7.20	6.97	
Factor	A	B	AB		A	B	AB		A	B	AB		A	B	AB		A	B	AB		A	B	AB	
SEm±	0.058	0.050	0.100		0.060	0.052	0.104		0.053	0.048	0.096		0.065	0.057	0.113		0.044	0.038	0.076		0.041	0.035	0.071	
CD at 5% level	0.170	0.147	NS		0.176	0.153	NS		0.162	0.141	NS		0.192	0.166	NS		0.129	0.112	NS		0.120	0.104	NS	

3.5 Overall acceptability

The overall acceptability of guava leather is dependent on colour, texture, flavour and taste rating of the product. The results obtained showed that highest score (8.96) for overall acceptability of guava leather was found in G3 (100% guava + 60% sugar) combination, shown in Table 5. Optimum quantity of sugar is the main reason for its better quality and acceptability of leather. Similar findings of results were reported by Jain and Nema (2007) [11] in guava leather. Similarly, Naikare *et al.* (1998) [13] reported the same result in processing of leather. During storage, it was observed that overall acceptability of guava leather was highest at 0 day of storage and it slightly decreased as the days of storage were increased. Similar results were found by Baramanray *et al.* (1995) [5] in guava nectar and by Harsimart and Dhawan (2001) [8] in guava fruit bar.

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