Processing of Pulp of Various Cultivars of Guava (*Psidium guajava* L.) for Leather Production

P. K. Jain[1*] and P. K. Nema[2]

[1]College of Agriculture, JNKVV, Indore, MP 452001, India
[2]College of Horticulture, JNKVV, Mandsaur MP 458001, India
*Corresponding Author: e-mail: drpkjain51@yahoo.co.in

ABSTRACT

A study was conducted to evaluate the quality of the leather from five different cultivars (Red Fleshed, Allahabad Safeda, Lucknow-49, Chittidar, Apple Colour of guava. Leather quality was also observed using three different recipes for its preparation. The study revealed that organoleptic quality (i.e. colour, flavour, taste, texture and overall acceptability) of leather decreased gradually with increase in the quantity of sugar added. The organoleptic quality of the pulp from Allahabad Safeda was found to be the best among all the cultivars followed by Lucknow-49. The maximum loss in weight was recorded in the leather made from Apple Colour and minimum in Allahabad Safeda. Mean values of moisture content increase significantly with increase in sugar content of leather. The highest moisture content was observed in leather from Red Fleshed. In the pulp total soluble solids (TSS) increased significantly with amount of sugar. The highest TSS was observed in Allahabad Safeda and Apple Colour. The leather acidity was affected by cultivars significantly. The maximum mean acidity was observed in leather from Allahabad Safeda and lowest in Red Fleshed. The acidity of the leather also decreased significantly with increase in sugar content. It was observed that the ascorbic acid content of leather of all cultivars showed decreasing trend with recipes when the sugar content was increased. The statistical analysis showed significant difference in the mean ascorbic acid content of leather due to different recipes.

Keywords: Guava, leather, cultivars, quality, recipes, India.

1. INTRODUCTION

Guava (*Psidium guajava* L.) is the forth most important commercial fruit in India in area and production after mango, banana and citrus. At present it occupies nearly 1.12 lakh ha. of land with production of 12.04 lakh tones and productivity 10.77 t/ha fruit per year in India (DAC, 2007). The fruit has about 83% moisture and is an excellent source of ascorbic acid and pectin but has low energy (66 cal/100g) and protein content (1%) (Bose et al., 1999). The fruit is rich in minerals like phosphorous (23-37 mg/100g), calcium (14-30 mg/100g), iron (0.6-1.4 mg/100g) as well as vitamins like niacin, pathotenic acid, thiamine, riboflavin, vitamin A (Bose et al., 1999). Guava is normally consumed fresh as dessert fruit that is pleasantly sweet and refreshing in flavour. The whole fruit is edible along with skin. It is considered as one of the most delicious and luscious fruit. 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). There has been a

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. Jain and Asati (2004) found that the cost of production of pulp is only Rs. 11/kg which is a raw material for guava leather. Leathers can be also be made from a wide variety of fruit including pawpaw, guava, banana and sweet potato (Collins and Hatsell, 1987).

Deterioration of pulp and leather quality during storage is mostly due to microbial spoilage and biochemical changes and therefore keeping quality intact during storage is a challenge. Preservatives are used to increase the shelf life of pulp and leather (Kalra and Revanthi, 1983; Sagar and Maini, 1993). Potassium metabisulphite is generally used for checking storage losses and deterioration of quality of pulp and leather. Sulphur dioxide is also widely used for preservation of juice, pulp, squash, nectar and RTS, as it also helps in better retention of caroteniods and flavour components during storage (Sethi and Maini, 1991; Sagar and Maini, 1993). Storage stability of guava fruit bar prepared using a new process has been discussed by Vijayanand et al. (2000).

A study was carried out to evaluate organoleptic and qualitative characters of various cultivars of guava for pulp and leather preparation. Results of guava pulp has already been discussed in detail (Jain and Asati, 2004). The present paper highlights the results of study of guava leather preparation and effects of various cultivars of guava on the organoleptic and qualitative parameters of leather.

2. MATERIALS AND METHOD

For the experiment, the guava pulp was prepared and stored as per the procedure shown and discussed in detail by Jain and Asati (2004). The average quality characters of guava of various cultivars used in this study is given in Table 1. The guava pulp was used for leather preparation. Sugar in three different quantities i.e. 10 (Recipe I : R1), 20 (Recipe II : R2) and 30% (Recipe III : R3) were mixed thoroughly with 1 kg pulp. The mixed pulp was spread on polythene sheet with about 6 mm thick layer and dried under sunlight upto 15% moisture level on wet basis. After drying was complete, leather was cut into small pieces, packed in poly bags and stored at low temperature (below 10^{o}C).

Table 1 Average quality characters of guava of various cultivars.

S. No.	Cultivars	Pulp Yield (%)	TSS (^{o}Brix)	pH	Acidity (%)	Ascorbic Acid (mg / 100g pulp)
1	Apple Colour (T1)	54.3	11.8	3.83	0.42	182.16
2	Lucknow-49 (T2)	54.6	12.8	3.80	0.45	246.00
3	Allahabad Safeda (T3)	54.8	13.3	3.57	0.48	261.00
4	Red Flashed (T4)	54.0	12.7	3.98	0.38	165.41
5	Chittidar (T5)	54.2	11.8	3.81	0.44	196.13

The organoleptic character (i.e. colour, flavour, texture, taste and overall acceptability) and qualitative character (i.e. TSS, pH, percent acidity, ascorbic acid content) 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) was adopted using a nine-point hedonic scale basis (1 = dislike extremely and 9 = like extremely). Moisture content was estimated according to method given in AOAC (1980). Thickness of the leather was measured with the help of micrometer before and after drying of leather. Percent loss in weight (PLW) was calculated by the weight loss during the sun drying based on initial weight of pulp. The total soluble solids in the pulp were measured with the help of hand refractometer. pH of extracted pulp was measured using Elemer pH meter after calibration of the instrument with standard buffer solutions. The titrable acidity and ascorbic acid content were determined by the method prescribed by AOAC (1980).

The data obtained in this study were subjected to statistical analysis by adopting the factorial completely randomized design to test the significant differences between the treatment mean for different recipes (Snedecor and Cochron, 1967).

3. RESULTS AND DISCUSSION

The results of organoleptic and qualitative parameters of the guava leather prepared using three different recipes and guava pulp of five cultivars are shown in Table 2. It is clear from the data that colour rating of leather decreased with increased sugar content i.e. the leather colour rating was highest in recipe I (RI), it is due to high pulp and sugar ratio. The highest mean score (6.95) for leather colour was observed in Allahabad Safeda leather followed by Lucknow-49 (6.83) and the lowest in Red Fleshed (6.66). Harsimrat and Dhawan (1998) reported that, fruit bar of Allahabad Safeda was found superior in colour followed by cultivar Lucknow-49.

The data on flavour value clearly shows that Allahabad Safeda had the best flavoured leather with a mean score of 7.25 followed by Lucknow-49 (7.10), Apple Colour (6.94), Red Fleshed (6.91) and the lowest in Chittidar (6.90). It is evident that the mean score of flavour rating decreases with increase in sugar content of leather. It was observed that the leather flavour rating was higher in recipe I, when 100g sugar was added. This is due to high pulp sugar ratio, whereas, lowest flavour rating was recorded in recipe III with addition of 300g sugar. Allahabad Safeda and Lucknow-49 were best flavoured due to their varietal character.

Table 2 Effect of cultivars and recipes on quality of guava leather.

Recipes	Treatments					Mean
	T1	T2	T3	T4	T5	
			Effect on colour			
R1	7.10	7.20	7.20	7.00	7.00	7.10
R2	7.00	7.10	7.16	7.00	7.10	7.07
R3	6.10	6.20	6.50	6.00	6.00	6.16
Mean	6.73	6.83	6.95	6.66	6.73	6.77
			Effect on flavour			
R1	7.42	7.62	7.83	7.38	7.46	7.54
R2	7.25	7.42	7.53	7.18	7.24	7.32
R3	6.15	6.28	6.40	6.17	6.00	6.20
Mean	6.94	7.10	7.25	6.91	6.90	7.02
			Effect on taste			
R1	6.12	6.24	6.61	6.00	6.00	6.19
R2	7.67	8.00	8.20	7.82	7.72	7.88
R3	5.82	6.16	6.22	6.00	5.90	6.02
Mean	6.53	6.80	7.01	6.60	6.54	6.69
			Effect on texture			
R1	6.19	6.72	6.42	6.00	6.13	6.20
R2	7.00	7.28	7.50	7.22	7.13	7.22
R3	5.32	5.44	5.50	5.43	5.36	5.41
Mean	6.17	6.33	6.47	6.21	6.20	6.27
			Effect on overall acceptability			
R1	6.70	6.83	7.01	6.54	6.64	6.75
R2	7.23	7.45	7.59	7.30	7.29	7.37
R3	5.84	6.02	6.15	5.90	5.81	5.94
Mean	6.59	6.76	6.91	6.59	6.58	6.68

The highest taste rating score (7.01) was observed in leather from Allahabad Safeda followed by Lucknow-49 (6.80), Red Fleshed (6.60), Chittidar (6.54) and the lowest in Apple Colour (6.53). It is clear from the Table 2 that leather from recipe II was found to be the best tasted recipe. Leather from recipe I was rated as the next best followed by recipe III. The highest score of taste in leather from recipe II was due to moderate addition of sugar in to pulp (i.e. 200 g sugar / kg pulp). 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 Naikare et al. (1998). Harsimarat and Dhawan (1998) also reported the fruit bar of Allahabad Safeda as superior followed by Lucknow-49.

The highest texture (6.47) was observed in leather from Allahabad Safeda followed by Lucknow-49 (6.33), Red Fleshed (6.21), Chittidar (6.20) and Apple Colour (6.17). It is clear from Table 2 that leather from recipe II was found to be the best textured recipe. The leather from recipe I was rated as the next best followed by recipe III. The leather from recipe I had low sugar, so leather became hard and had more chewiness. Whereas, due to higher sugar content (300 g) leather texture was viscous and had less chewiness. Therefore, the optimum sugar (200g) in this study

added to leather of recipe II proved be the best rated and texture of leather was also found excellent.

A critical perusal of the data presented in Table 2 clearly shows that overall quality and acceptability of leather is the highest (7.37) in leather with recipe II followed by leather with recipe I (6.75) and the lowest in leather with recipe III (5.94). Further it was recorded that the highest score for overall quality and acceptability (6.91) was in leather from Allahabad Safeda followed by Lucknow-49 (6.76), Red Fleshed (6.59), Apple Colour (6.59) and lowest in Chittidar (6.58). Optimum quantity of sugar (200 g) is the main reason for it's better quality and acceptability of leather. Similar results were reported by Naikare et al. (1998). The leather from recipe I was also good but it had a fair taste, more chewiness but hardiness in texture. Harsimrat and Dhawan (1998) reported that Allahabad Safeda was found superior followed by Lucknow-49 in preparation of guava fruit bar.

The data in Table 3 reveals an appreciable increase in thickness of leather with increase in sugar content. Initial thickness of guava pulp for drying was 6 mm and after the drying, the thickness of leather in recipe I, recipe II and recipe III was 1.46, 1.98 and 2.16mm respectively. Naikare et al (1998) also suggested initial thickness of leather 5 mm for better drying of leather. The statistical analysis indicated the significant variation in thickness of leather due to different recipes. However, non-significant variation was observed in thickness of leather of different cultivars as revealed by the Table 3. The leather prepared from Allahabad Safeda had maximum thickness (2.06mm) followed by Lucknow-49 (1.96mm), Red Fleshed (1.80mm), Chittidar (1.76mm) and lowest in Apple Colour (1.73mm). Thickness of leather might be directly related with the texture of pulp and quantity of sugar added.

The data showed that the percent loss in water (PLW) during drying the guava leather decreased significantly with increasing sugar content. The PLW was more (71.59%) in leather prepared with 100g sugar as compared to leather with higher sugar i.e. 300g. The loss in weight depends upon the quantity and texture of pulp. If quantity of sugar is more the PLW will be low, whereas the quantity of sugar is low the PLW will be high. (This statement may be deleted as it is obvious). Leather ('prepared' may be added) from various cultivars affected the PLW ('during drying of the guava pulp' may be added in place of 'of leather') non significantly. The maximum loss in weight was recorded in ('the' may be added) leather ('made' may be added) from Apple Colour (67.8%) and minimum in Allahabad Safeda (65.71%). The maximum loss in weight was recorded in the leather made from Apple Colour and minimum in Allahabad Safeda due to their varietal characters.

Mean values of moisture content increase significantly with increase in sugar content of leather (is not it 'added sugar to pulp'?). The highest moisture was found in leather with recipe III (14.67%) and lowest in leather with recipe I (12.78%) (Basis of moisture content may be included). It was further evident that the variation ('s' is missing) in ('the' may added) moisture content of ('the' may be added) leather from different cultivars were non significant. The highest moisture content was observed in leather ('made' may be added) from Lucknow-49 (14.23%) and lowest in Allahabad Safeda (13.38%). Harsimrat and Dhawan (1998) reported that 15% final

moisture level is optimum for good quality guava fruit bar. Naikare et al (1998) found that 16% moisture level in fruit leather had extended shelf life and retained sensory and physical quality up to six months.

Table 3 Effects of cultivars and recipes on quality of guava leather.

Recipes	Treatments					Mean
	T1	T2	T3	T4	T5	
			Effect on thickness (mm)			
R1	1.40	1.50	1.60	1.40	1.40	1.46
R2	1.80	2.10	2.20	1.90	1.90	1.98
R3	2.00	2.30	2.40	2.10	2.00	2.16
Mean	1.73	1.96	2.06	1.80	1.76	1.86
CD at 5% level						
	Cultivars : NS					
	Recipes : 0.21					
			Effect on PLW (%)			
R1	72.00	71.74	70.36	71.40	72.46	71.59
R2	70.65	68.78	67.66	69.23	69.68	69.20
R3	60.79	60.53	59.12	61.87	60.50	60.52
Mean	67.80	66.95	65.71	67.50	67.55	67.10
CD at 5% level						
	Cultivars : NS					
	Recipes : 1.20					
			Effect on moisture content (%)			
R1	12.36	13.03	12.65	13.15	12.75	12.78
R2	14.10	14.50	13.50	14.26	13.26	13.92
R3	14.43	15.16	14.00	15.26	14.50	14.67
Mean	13.63	14.23	13.38	14.22	13.50	13.79
CD at 5% level						
	Cultivars : NS					
	Recipes : 1.20					
			Effect on TSS (^{o}Brix)			
R1	20.73	20.30	22.40	21.20	18.83	20.71
R2	26.56	28.66	27.10	25.20	22.50	26.02
R3	29.50	31.00	30.03	29.40	30.00	30.00
Mean	25.6	26.67	26.53	25.31	23.77	25.57
CD at 5% level						
	Cultivars : 2.45					
	Recipes : 1.90					

			Effect on percent acidity			
R1	1.81	2.05	2.17	1.62	2.01	1.94
R2	1.62	1.81	1.94	1.57	1.67	1.72
R3	1.42	1.51	1.44	1.27	1.34	1.40
Mean	1.62	1.80	1.85	1.49	1.67	1.68
CD at 5% level						
	Cultivars : 0.22					
	Recipes : 0.17					
			Effect on ascorbic acid content (mg/100g)			
R1	144.62	194.58	215.04	156.25	170.90	176.27
R2	102.24	163.03	178.96	112.52	147.57	140.86
R3	94.64	105.61	108.34	109.42	106.36	104.87
Mean	113.83	154.41	167.44	126.06	141.61	140.66
CD at 5% level						
	Cultivars : 29.63					
	Recipes : 22.95					

A perusal of the above table indicated that the pulp with more sugar significantly increased the TSS in the leather. It was observed that different cultivars of guava also affected the TSS content of pulp significantly. The highest TSS (26.67^{o}B) was observed in Lucknow-49 followed by Allahabad Safeda (26.53 ^{o}B), Apple Colour (25.6 ^{o}B), Red Fleshed (25.31 ^{o}B) and lowest in Chittidar (23.77^{o}B). This was due to the varietal character. Roy and Singh (1979) reported that addition of sugar at 10% level greatly improves the organoleptic rating of the bael slab. Naikar et al. (1998) reported that 20^{o}B sugar mixed with pulp produced good quality leather.

Leather acidity was affected by cultivars significantly. The maximum mean acidity (1.85%) was observed in leather made from Allahabad Safeda followed by Lucknow-49 (1.80%), Chittidar (1.67%), Apple Colour (1.62%) and lowest (1.49%) in Red Fleshed. The mean value of acidity decreased from leather from recipe I (1.94%) to leather with recipe III (1.40%). The statistical analysis showed significant difference in the mean acidity value with different recipes. This was due to increase in final weight of pulp otherwise the absolute amount of acidity is the same. The higher acidity in leather made from Allahabad Safeda was due to varietal character. Red Fleshed leather was found with less amount of acidity. Garg et al. (1993) found that commercial sample of mango leather have higher acidity than lab sample. Harsimarat and Dhawan (1998) reported a significant increase in acidity of guava fruit bar during storage.

It was observed that the ascorbic acid content of leather of all cultivars showed decreasing trend with recipes when sugar content was increased. The combined mean value of ascorbic acid decreased from 176.27 mg/100g in recipe I to 104.87 mg/100g in recipe III. The statistical analysis showed significant difference in the mean ascorbic acid content of leather due to different recipes. Das et al. (1954) reported the loss of ascorbic acid during the preparation and storage of dried mango pulp. The ascorbic acid content was more in leather with recipe I, which might be due to the less sugar content and more pulp. An increase in sugar content decreased the

ascorbic acid value in different recipe of leather. The maximum ascorbic acid content was observed in the leather prepared from Allahabad Safeda due to it's varietal character followed by Lucknow-49.

4. CONCLUSION

It can be concluded from the study that organoleptic quality (i.e. colour, flavour, taste, texture and overall acceptability) of leather decreased gradually with increase in the quantity of sugar added. Organoleptic quality of the pulp from Allahabad Safeda was found to be the best among all the cultivars followed by Lucknow-49. The maximum loss in weight was recorded in the leather made from Apple Colour and minimum in Allahabad Safeda. Mean values of moisture content increase significantly with increase in sugar content of leather. The highest moisture content was observed in leather from Red Fleshed. The pulp with sugar significantly increased the TSS. The maximum TSS was observed that different cultivars of guava also affected the TSS content of pulp significantly. The highest TSS was observed in Lucknow-49 and Allahabad Safeda. Leather acidity was affected by cultivars significantly. The maximum mean acidity was observed in leather from Allahabad Safeda and lowest in Red Fleshed. However, acidity of the leather also decreased significantly with increased sugar content. The mean value of acidity decreased from leather from recipe I to leather with recipe III. It was observed that the ascorbic acid content of leather of all cultivars showed decreasing trend with recipes when increase in the sugar content.

5. REFERENCES

A.O.A.C. 1980. Method of analysis of the association of official agricultural chemists. Washington D.C, USA

Amerine, M. A., Pangborn, R. N. and Roessler, E. B. 1965. *Principles of Sensory Evaluation of Food*, Academic Press, New York.

Bose, T. K., Mitra, S. K., Farooqui, A. A. and Sandhu, M. K. 1999. *Tropical Horticulture* 1st ed. Nava Prokash Publication, Kolkata : 297.

Collins, J. L. and Hutsell, L. W. 1987. Physical, Chemical, Sensory and Microbiology attributes of sweet potato leather. *J. Food Sci.* 52:646-648.

DAC (2007) Department of Agriculture and Cooperation (DAC), Ministry of Agriculture, Govt of India. Web: http://agricoop.nic.in/hort/hortrevo5.htm

Das, D. P., Jain, N. L. and Lal, G. 1954. Losses of ascorbic acid and carotene during the preparation and storage of dried mango pulp. *Bull* 4, CFTRI Mysore, pp157.

F. A. O. 1983. *Production Yearbook,* 1982, Rome.

Garg, N., Kalra, S. K. and Tandon, D. K. 1993. Quality evaluation of market raw mango powder and mango leather. *Beverage and Food World,* 20(2): 13-14, 18.

Harsimrat, K. and Dhawan, S. S. 1998. Preparation of guava fruit bar. *Poster abstrct.* IFCON O-04: 533.

Jain, P. K. and Asati V. K. 2004. Evaluation of guava cultivars for pulp preparation. *J. Fd Sci. Technol.* 41(6): 684-686.

Kalra, S. K. and Revanthi, G. 1983. Chemical and microbial evaluation of stored guava pulp in PVC container. *J. Fd. Sci. Technol.* 20(3):118-120.

Naikare, S. M., Jadhaw, M. S. and Gawade, B. J. 1998. Processing of fruit leather and avaluation of its quality during storage. Poster abstract. IFCON C-5:22.

Roy, K. S. and Singh, R. N. 1979. Studies on utilization on bael fruit fo processing. *Indian Food Packer.* 33(6): 3-9.

Sagar, V. R. and Maini, S. B. 1993. Economic utilization of rainy season guava drying aspects. *Indian Fd. Packer* 46(6):19-22.

Sethi, V. and Maini, S. B. 1991. Studies on storage of mango pulp. *Indian J. Hort.* 48(8):228-231.

Snedecor, G. M. and Cochron, W. C. 1967. *Statistical Methods*, Oxford and IBH Publishing Co. Calcutta.

Vijayanand, P. Yadav, A. R. Balasubramanyam, N. and Narasimham P. 2000. Storage stability of guava fruit bar prepared using a new process. *Lebensmittel-Wissenschaft und-Technologie*. 33(2):132-137.

Yadav, I. S. 1997. Search for quality cultivars, *The Hindu, Survey of Indian Agriculture* pp132.