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Original Research Article

Effect of Recipes and Storage on Chemical Attributes of Guava Leather

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Guava, Leather, Dehydrated fruit, Storage, Chemical parameters

A B S T R A C T

Dehydrated fruit processing is gaining importance area now-a-days due to long shelf life, light weight, better handling during export and providing variety to the consumers. Fruit leathers are dehydrated fruit based products. A laboratory experiment was conducted at Post Harvest Laboratory, Horticulture Section, College of Agriculture and Analytical Laboratory, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2016-17, with objective to study the storability of guava leather prepared by using pulp of different varieties of guava for preparation of superior guava leather. The experiment was laid out in Factorial Completely Randomized Design with two factors. Two varieties of guava *viz*., A_1 (L-49) and A_2 (Lalit) and six recipes with different level of sugar and citric acid *viz*., R_1, R_2, R_3, R_4, R_5, R_6 (Sugar(g) + Citric Acid%), to study the storability effect on guava leather at ambient condition for 120 days storage. With regarding the chemical parameters of leather *viz.* TSS, acidity, pH, total sugars, reducing sugars, non-reducing sugars, ascorbic acid. Amongst the different recipes R_1 (500g sugar + 2% citric acid/1 kg pulp) of L- 49 variety of guava was found to be superior for chemical parameter *viz.* TSS, acidity, pH, ascorbic acid, total sugars, reducing sugars and non-reducing sugars during storage.

Introduction

Guava, the “poor man’s fruit” or “apple of the tropics” is a popular tree fruit of the tropical and subtropical climate. It occupies nearly 3.7% area of total fruit production in India. Guava is considered to be one of the most exquisite and nutritionally valuable crops. It contains about 83% moisture and is an excellent source of ascorbic acid (413mg/100g) and pectin but has low energy (66cal/100g) and protein content (1%). 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 Vitamin A, Niacin, Pathotenic acid, Thiamine, Riboflavin (Bose *et al.*, 1999).

The Vitamin C contents of the guava fruit are four to five times higher than those of the citrus fruits. It falls in the category of super fruits as rich in dietary fibre, Vitamin A, Folic acid and the dietary minerals of K, Cu and Mn and seeds are rich in Omega-3 Omega-6 poly saturated fatty acids and especially dietary fibre, riboflavin as well as its proteins and mineral salts (Kadam *et al.*, 2012).

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, leather, ice cream and toffees can be made from guava fruit (Jain and Asati, 2004). There has been a great increase in the production rate of these fruits over the years, and this may be due to their increased consumption pattern in the tropics (Anon, 2008).

Guava is common experience 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 also generates 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. Dehydrated fruit processing is gaining importance area now-a-days due to long shelf life, light weight, better handling during export and providing variety to the consumers. The advantage is that during dehydration the moisture content is reduced greatly and the microorganisms like moulds and fungi do not thrive. This keeps the food for longer duration without spoilage. Due to abundant availability of solar radiation, attention has been gradually diverting to utilize this renewable energy for a number of applications (Sarojini *et al.,* 2009).

The main advantages of making fruit leather is to preserve fruit by drying and, hence, controlling postharvest spoilage. Making fruit leather, from ripe or slightly over-ripe fruits that are not suitable for fresh consumption will enable producers to satisfy market demand during off season periods. Fruit with minor blemishes and bruises that is not suitable for canning and freezing can be used to make fruit leather (Raab and Oehler, 1999). 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. Moreover, fruit pulp left from making jellies, during prolonged time in reduced volumes may also be converted into leathers. In recent years, their popularity has increased, transforming from a homemade preparation into an industrial product.

Although fruit leather is a relatively well established product overseas, few academic studies have been published on the topic. Fruit leathers, however, can be prepared without the addition of any preservatives or sweeteners (Azeredo, 2006). Studies on fruit leathers have shown that fruit puree can be mixed with other ingredients (especially sugars) and additives to enhance the texture, flavour and colour of the final product. Popular ingredients are ascorbic acid, citric acid for colour preservation (to avoid darkening during drying), honey and sugar (to sweeten the product), nutmeg, cinnamon, chopped nuts and coconut (as a flavours) (Raab and Oehler, 1999). Different types of fruit can also be mixed together to prepare a fruit leather (Kumar *et al.,* 2010) prepared papaya fruit leather by blending it with guava pulp to enhance the papaya's flavour.

This was necessary as the poor odour of the fruit was its main hindrance in the commercial exploitation of this fruit in processing. Similarly, a mixed fruit leather was processed by mixing sapota pulp, mango pulp, papaya pulp, banana pulp and soya milk powder (Bharambhe *et al.,* 2009). The product was found to be acceptable during sensory evaluation. As processing of guava to leather, is a simple and less tedious process and claims cheaper production cost, so grower can adopt easily. So it should be conveniently used by grower as lower cost of production and by processing the product they minimize loss and got fair profit.

Materials and Methods

The research was conducted at Post-Harvest Technology Laboratory, Horticulture Section, College of Agriculture and Analytical Laboratory, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2016 – 17. The details of material used and methods adopted during the course of investigation are presented under the appropriate headings and sub headings.

Treatment details

The experiment comprises of 12 treatment combinations in FCRD with two factors i.e. A and R. Factor "A" is variety with 2 levels *i.e*., Lalit and L- 49 and factor "R" is recipe for preparation of guava leather with 6 levels i.e sugar (500g,750g,1000g), citric acid (2% and 4%). Leather prepared were wrapped in aluminium foil and kept in plastic boxes. The packed boxes were stored at ambient temperature (30 ± 2 ^{0}C) and evaluation of chemical changes and sensory qualities were done at 30days interval during storage up to 120days. Combinations are $A_1 R_1$, $A_2 R_1$, $A_1 R_2$, $A_2 R_2$, $A_1 R_3$, $A_2 R_3$, $A_1 R_4$, $A_2 R_4$, $A_1 R_5$, $A_2 R_5$, $A_1 R_6$, $A_2 R_6$.

Materials and Methods

Selection of fruit

Fruits of two cultivar of guava cv. L-49 and Lalit were procured from Main garden, Department of Horticulture, Dr. PDKV, Akola. Fully ripe, over ripe, apparently healthy and bird damaged fruits were selected for experiment to minimise post-harvest losses. Injured and diseased parts of fruits were sorted out.

Flow chart for leather

Fully ripe fruit, Washing, Cutting, Deseeded, Blanched at 85^{0}C for 5minutes, Pulping (Addition and mixing of sugar, citric acid, salt and KMS per treatment), Smearing with glycerol, Spreading the pulp in thin layer (0.5-1cm), Drying in drier (50°C for 6 – 8 hrs.), Cutting into desired size, Again drying for 8-10hrs, 3 layer keeping together and pressing properly to form one sheet, Cutting into 3×4 cm size, Drying under fan for 2-3 hour, Wrapping into Al. foil, Keeping in plastic boxes for storage study of 4months, Fruit leather

Results and Discussion

Guava leather chemical parameters

TSS

During storage of leather initially the TSS content of guava leather increased rapidly up to 60th days of storage and thereafter the gradual increase was observed in 60th to 90th days and then again increased rapidly in 90th and 120th days in storage period as compare to earlier trend.

Titratable acidity

During storage period the acidity content of fruits increased in all treatment combinations. Acidity is an important quality factor related to the flavour of product.

High acidity in fruit leather prevents the growth of microorganisms and helps to maintain the colour and flavour of the fruit (Minakschhi, 2011). The data indicated that, both varieties and recipes influenced significantly, however effect of interaction among factors was found non-significant effect.

Table.1 (a) Interaction effect of different varieties and various recipes on non-reducing sugar reducing sugar, and TSS of guava leather during storage

Treatment	**Non Reducing sugar (%)**					**Reducing sugar (%)**					**TSS**				
	Storage(days)					**Storage(days)**					**Storage(days)**				
	Initial	**30**	**60**	**90**	**120**	**Initial**	**30**	**60**	**90**	**120**	**Initial**	**30**	**60**	**90**	**120**
$A_1 R_1$	49.97	49.66	49.22	48.70	48.53	14.17	14.80	15.61	15.61	17.20	68.92	69.390	69.960	69.827	70.080
$A_1 R_2$	50.73	51.59	51.56	51.44	51.18	16.33	16.73	17.16	17.16	18.23	69.24	70.020	70.517	70.907	71.620
$A_1 R_3$	51.17	51.00	50.79	50.70	50.24	18.17	18.70	19.23	19.23	20.43	70.11	71.090	71.310	72.253	73.113
$A_1 R_4$	50.00	49.83	49.49	49.17	48.55	14.17	14.63	15.333	15.333	16.95	68.65	69.300	69.660	69.887	70.040
$A_1 R_5$	50.90	51.57	51.45	48.37	51.10	16.17	16.73	17.303	17.303	18.33	69.19	70.000	70.563	71.013	71.580
$A_1 R_6$	51.20	50.96	49.84	50.70	50.27	18.23	18.76	19.267	19.267	20.36	69.88	71.030	71.250	72.073	73.007
$A_2 R_1$	49.83	49.61	49.04	48.84	48.49	14.27	14.86	15.767	15.767	17.26	68.42	68.973	69.380	69.873	70.010
$A_2 R_2$	51.07	51.56	51.49	48.34	50.91	16.20	16.76	17.267	17.267	18.50	69.15	69.923	70.050	71.123	71.320
$A_2 R_3$	51.00	50.89	50.27	50.51	50.21	18.23	18.78	19.437	19.437	20.43	69.75	70.840	71.110	72.260	72.823
$A_2 R_4$	49.87	38.04	49.05	48.94	48.51	14.23	14.73	15.750	15.750	17.23	68.57	69.083	69.273	69.540	69.990
$A_2 R_5$	50.72	51.54	51.39	48.32	50.99	16.37	16.78	17.30	17.30	18.43	69.16	69.86	69.80	71.12	71.28
$A_2 R_6$	50.923	50.870	50.643	50.507	50.177	18.31	18.820	19.400	19.400	20.467	69.133	70.720	71.043	72.560	73.380
"F" test	NS							Sig.	NS		NS				
SE(m)±	0.116	3.343	484.419	1.506	0.087	0.073	0.063	0.050	0.067	0.057	0.722	0.185	0.287	0.264	0.171
C.D. at 5%	–	–	–	–	–	–	–	0.147	--	–	–	–	–	–	–

Table.1 (b) Interaction effect of different varieties and various recipes on Total Sugar, pH and Ascorbic Acid of Guava Leather during storage

Treatment	**Total sugar (%)**					**pH**					**Ascorbic Acid (mg/100 g)**				
	Storage (days)					**Storage (days)**					**Storage (days)**				
	Initial	**30**	**60**	**90**	**120**	**Initial**	**30**	**60**	**90**	**120**	**Initial**	**30**	**60**	**90**	**120**
$A_1 R_1$	64.13	64.49	64.81	65.33	65.73	3.743	3.682	3.653	3.581	3.534	121.02	111.72	97.65	89.85	74.86
$A_1 R_2$	67.07	68.33	68.72	69.07	69.42	3.902	3.872	3.813	3.733	3.769	117.26	108.14	98.50	84.37	70.89
$A_1 R_3$	69.33	69.70	70.03	70.37	70.67	3.944	3.900	3.832	3.775	3.733	116.52	105.72	94.48	85.42	71.49
$A_1 R_4$	64.17	64.50	64.96	65.37	65.72	3.788	3. 57	3. 52	3.402	3.452	119.84	109.40	97.48	89.11	74.81
$A_1 R_5$	67.07	68.31	68.80	69.11	69.44	3.983	3.632	3.572	3.471	3.433	117.82	107.56	95.81	85.76	73.35
$A_1 R_6$	69.43	69.73	70.07	70.40	70.64	3.922	3.782	3. 73	3.631	3.381	116.93	108.05	97.31	85.19	71.11
$A_2 R_1$	64.10	64.48	64.97	65.37	65.78	3.944	3.873	3.873	3.750	3.720	98.71	87.73	78.05	64.72	47.95
$A_2 R_2$	67.07	68.33	68.81	69.10	69.42	3.922	3.882	3.850	3.781	3.761	97.12	86.34	75.74	66.89	51.37
$A_2 R_3$	69.23	69.68	70.03	70.40	70.64	3.983	3.951	3.893	3.793	3.784	98.48	87.75	76.48	67.08	55.06
$A_2 R_4$	64.10	64.45	64.88	65.34	65.74	3.658	3.623	3.563	3.464	3.351	96.33	84.77	76.22	63.58	52.28
$A_2 R_5$	67.07	68.29	68.75	69.11	69.67	4.011	3.996	3.949	3.822	3.777	95.92	84.02	73.59	66.46	51.09
$A_2 R_6$	69.23	69.69	70.06	70.41	70.64	4.069	4.033	3.941	3.833	3.813	98.69	86.05	72.79	66.99	53.53
"F" test	Sig.	Sig.	Sig.	Sig.	Sig.	NS	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	0.073	0.032	0.028	0.034	0.026	0.043	0.012	0.014	0.017	0.007	0.645	0.662	0.942	0.577	0.620
C.D. at 5%	0.215	0.093	0.081	0.087	0.077	N/A	0.036	0.041	0.051	0.021	1.739	1.945	2.767	1.694	1.819

Plate.1 A view of guava leather at 120^{th} days of storage

A_1R_1 A_1R_2 A_1R_3

A_1R_4 A_1R_5 A_1R_6

A_1R_4 A_1R_5 A_1R_6

A_1R_1 A_1R_2 A_1R_3

pH

During the period of storage the pH content of leather increased in all treatment combination. Both varieties and recipes influenced significantly on pH of leather and effect of interaction among factors was significant effect on pH of leather. Decrease in pH might be due to the addition of citric acid in treatments. The results are in conformation by the results obtained by Kalra and Revanthi (1983) reported that slightly decreased in pH during 60 days storage of guava pulp. Mahendran (2010) reported that the acidity increased with corresponding decreases in pH. This might be due to the formation of organic acid by ascorbic acid degradation.

Reducing sugars

A significant variation in reducing sugar content of guava leathers was observed during storage. The content of reducing sugars in guava leathers increased with progress of storage period and also increases with increase in sugar concentration.

Non-reducing sugar

A significant variation in non-reducing sugar content of guava leathers was observed during storage. The con tent of reducing sugars in guava leathers decreased with progress of storage period and also increases with increase in sugar concentration.

Ascorbic acid

During storage of leather initially the ascorbic acid content of guava leather decreased rapidly up to 120th days of storage as ascorbic acid sensitive to heating and drying. Significant variation due to factor interaction was observed in 0th, 30th, 06th, 90th and 120th days of storage. During total month of storage except 60th days, treatment combination A1R1 was found significantly maximum recorded as (121.023, 111. 720, 89.850 and 74.863) mg/100g respectively which was at par with treatment combination A1R4 recoded as (119.840, 109.400, 89.107, 74.810) mg/100g respectively. While minimum ascorbic acid was found in treatment combinations A2R5 and A2R6.

Economics of treatment

According to net monetary return obtained from treatment A1R1 and A2R1 found with high benefit cost ratio (1.67) which was followed by A2R5and A1R5 lowest benefit cost ratio was found in treatment A2R6, A1R6(both variety with 1000g sugar and 4% citric acid) i.e., (1.26).

The fresh fruit pulp of Sardar guava contained average values of TSS (14.9 %), pH (3.63%) acidity (0.45 %), reducing sugars (5.47 %), and ascorbic acid (208 mg/100 g). The fresh fruit pulp of Lalith variety contained ºBrix (14.2 %), pH (3.21%), acidity (0.38 %), reducing sugars (5.33 %), and ascorbic acid (179 mg/100 g).

The fresh guava leather prepared from Sardar guava contained average values of TSS (69.33 ºB), acidity (0.422 %), pH (3.70%), reducing sugars (16.20 %), and ascorbic acid (111.72 mg/100g), and the leather prepared from Lalith guava contained TSS (68.13ºB), acidity (0.369 %), pH (3.55%), reducing sugars (16.26 %), and ascorbic acid (87.73 mg/100 g).

Guava leather of Lalit variety (A_1) prepared with recipe 500g sugar + 2% citric acid (R_1) was found significantly superior in chemical parameters and change in chemical parameters were noticed as TSS (69.94 to

73.36 ºB), acidity (0.425 to 0.531%), pH (3.843 to 3.627%), total sugars (64.12-65.76%reducing sugars (14.22 – 17.23 %), non-reducing sugars (49.87 – 48.51 %) and ascorbic acid (109.87-64.78 mg/100g). The interaction effects were found to be significant influence in respect of pH, total sugars, reducing sugars and ascorbic acid whereas the interaction effect of was found non-significant variation in respect to TSS, acidity and non-reducing sugars.

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