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Studies on storability of guava pulp

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Abstract
This study was carried out to evaluate the best preservation methods and suitable variety for guava pulp preservation. For this the pulp of two guava varieties (L-49 and G-Vilas) were preserved at -20 ^{0}C with eight different treatments *viz.*, L-49 + sodium benzoate 0.1% (V_1P_1), L-49 + potassium metabisulphite 0.1% (V_1P_2), L-49 + potassium sorbate 0.1% (V_1P_3), L-49+ Control (V_1P_4), G-Vilas + sodium benzoate 0.1% (V_2P_1), G-vilas + potassium metabisulphite 0.1% (V_2P_2), G-Vilas + potassium sorbate 0.1% (V_2P_3), G-vilas + Control (V_2P_4)) replicated three times under factorial complete randomized design. The results revealed that the pulp preserved with potassium metabisulphite was better with over all qualitative attributes *viz.*, TSS, ascorbic acid, pH, sugars and sensory attributes value higher and acidity, and microbial count lower. Compared to L-49 and G-vilas guava varieties pulp storage L-49 was found significantly superior for titratable acidity, ascorbic acid content, total sugars, reducing sugars and non-reducing sugars content of guava pulp and variety V_2 (G-Vilas) was found significantly superior for TSS and pH content.

Keywords: Storability, guava, pulp, G-Vilas, sorbate

Introduction
Guava is one of the most exquisite, nutritionally valuable and remunerative fruit of the tropics and belongs to the family "Myrtaceae". It is native of tropical America. Guava is also called the "Apple of Tropics" and "Poor man's apple". Guava is quite hardy, prolific bearer and highly remunerative even without much care. It is widely grown all over the tropics and sub-tropics including India. Guava is a fruit with sweet aroma and a pleasant sour-sweet taste. It is the fourth most important fruit in areas and production after mango, banana and citrus.

Guava fruit normally consumed as a dessert fruit due to excellent flavour, high digestive and nutritive value, high palatability and availability in abundance of guava fruits show great potential for processing into valuable products, which have nutritional as well as health benefits. It's a better option for further use to make number of processed products such as nectar, squash, clarified juice, concentrates, canned, dehydrated powder, jam, RTS, cheese and blends with other juices.

Guava tree bears two cropping season i.e., rainy and winter season in sub tropics. Guava tree has tendency to bear maximum crop during rainy season. This crop is poor in quality and the fruit are rough, insipid taste and watery and infected by fruit fly. Rainy season fruits owing to high perishability, less storability (not more than 3 days) and poor taste restrict its consumption as the fresh fruit in this season and farmers could not get reasonable price of their produce. Generally post-harvest losses occurs about 22 percent (Bons and Dhawan, 2006). Therefore, need of the hour to use this rainy season crop through storage in form of pulp to increase its availability over an extended period and to stabilize the price during glut season and can be further utilize for preparation of various value added products (jam, RTS, squash, puree, chees, toffee, powder and other drinks). This product has good potential for internal as well as external trade.

Like other fruit's pulp storage, guava pulp can also be preserved by use of permitted food grade preservative chemicals (sodium benzoate, potassium metabisulphite, potassium sorbate etc.,) and low temperature (frozen storage) storage for maintaining the keeping quality during storage. Surplus produce use in processing of fruit into various products is one of the best ways to reduce post-harvest losses.

Therefore, it is, necessary to utilize guava for making nutritious processed health food like pulp storage to increase availability over an extended period and to utilize the produce at the time of glut and to save it from spoilage and can be further utilized for preparation of various value added products.

Material and Methods

The present investigation entitled "Studies on storability of guava pulp" was conducted in Post- Harvest Technology Laboratory, Department of Fruit Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2020 – 2021. Fully mature and ripe guava cv. L-49 and G-vilas fruits were procured from Krishi Vigyan Kendra Buldana. For pulp extraction, guava fruits were peeled out, cut into small pieces and then the pulp was extracted by using grinder on low speed. The seeds were separated from the pulp by passing the pulp through the sieve.

After the extraction of pulp different preservatives are added in proportion of 1 gram of preservative (Sodium Benzoate, Potassium metabisulphite and Potassium Sorbate) in 1 kg of guava pulp and again thoroughly homogenized the pulp to mix the preservatives uniformly. Then filled 300 g pulp per plastic containers. The packed container were stored at -20^{0}C temperature for evaluation of chemical changes and sensory qualities at 30 days interval during storage up to 120 days

Obtained pulp was preserved with eight different treatments namely, L-49 + sodium benzoate 0.1% (V_1P_1), L-49 + potassium metabisulphite 0.1% (V_1P_2), L-49 + potassium sorbate 0.1% (V_1P_3), L-49+ Control (V_1P_4), G-vilas + sodium benzoate 0.1% (V_2P_1), G-vilas + potassium metabisulphite 0.1% (V_2P_2), G-vilas + potassium sorbate 0.1% (V_2P_3), G-vilas + Control (V_2P_4) and replicated three times with two units. Physico-chemicals parameters of samples were observed at 0, 30, 60, 90 and 120 days of storage. The TSS content of pulp was directly measured by the "Digital Refractometer" (Brix: 0.0 to 53.0%) at 20 ^{0}C temperature. Ascorbic acid by 2,6-dichlorophenol – indophenols dye method and acidity content of pulp was determined by diluting the known volume of pulp with distilled water and titrating the same against standard N/10 sodium hydroxide solution, using phenolphthalein as an indicator (A.O.A.C., 1995). Reducing sugars was measured by following "DNS Method" (Miller, 1959). Total Sugar was estimated by using "Anthrone Method" (Dubois *et al.*, 1951). The pH of the pulp was directly measured on the pH meter. The data were analysed by using Factorial completely randomized design (Fisher, 1950).

Results and Discussion

TSS: It is evident from the data (Table 1) that TSS content of stored guava pulp was increased with the advancement of storage period in all the treatments. The mean maximum TSS content were recorded in the V_2P_2 (13.47^{0}B) and minimum in V_1P_4 (12.89^{0}B) after 120 days of storage. The increment in TSS content of preserved guava pulp during storage was probably due to conversion of free polysaccharides (starch) into monosaccharide (Jain *et al.* 2007) [7]. TSS content during storage have positive proportional trend (Desai *et al.*, 2012 [6] in mango pulp and Chand and Gehlot, 2006 [5] in *bael* pulp).

Acidity

The results indicate that the acidity of preserved guava pulp was increased with the advancement of storage period (Table 1). The mean maximum acidity (0.79%) was recorded in the treatment V_2P_3 and minimum (0.61%) was in the V_1P_2 (L-49+Pot. metabisulphite) after 120 days of storage. The increment in acidity of preserved guava pulp during storage period was due to formation of organic acids by degradation of ascorbic acids (Bal *et al.*, 2014) [3].

pH

The pH was decreased slightly with the advancement of storage period (Table 2). The Maximum pH (3.62) was recorded in V_1P_2 (L-49+Pot. metabisulphite) and minimum pH (3.48) was recorded in V_1P_4 (L-49+ Control) after 120 days of storage. Decrease in pH might be due to the formation of free acids and pectin hydrolysis (Ahmad *et al.*, 2000) [1].

Ascorbic acid

Ascorbic acid content of guava pulp was decreased with advancement of storage period (Table 2). The maximum ascorbic acid content was retained in treatment V_1P_2 (L-49+Pot. metabisulphite) *i.e.*, 163.33 mg 100g^{-1} and minimum in treatment V_2P_4 (G-vilas+control) *i.e.*, 105.06 mg 100g^{-1} at the end of storage period (120th days). Decrease in ascorbic acid content was due to the oxidation of ascorbic acid to de hydro ascorbic acid and then further degraded to 2, 3-diketo-gluconic acid by the action of ascorbic acid oxidase enzyme. The present study is in the cognizance with the findings of Bons *et al.*, (2011) [4].

Reducing sugar

The increment in reducing sugar with the advancement of storage period in all the treatments (Table 3), maximum reducing sugar content was recorded from treatment V_1P_2 (L-49+Pot. metabisulphite) *i.e.*, 8.25 per cent and minimum in treatment V_2P_4 (G-vilas+ control) *i.e.*, 7.91 per cent at the end of storage days. It might be due to breakdown of some of the hemicelluloses and other saccharides into simple soluble sugars. The present study supported by the findings of Tandon and Kalra (1984) [11] in guava pulp and Desai *et al.*, (2012) [6] in mango pulp.

Total sugar

It is evident from the data (Table 3) total sugar content of stored guava pulp was increased with the advancement of storage period in all the treatments. The maximum total sugar content (10.22%) was recorded in V_1P_2 (L-49+Pot. metabisulphite) and minimum (9.80%) was recorded in L-49+ Control (V_1P_4) The total sugar content of guava pulp increased in all samples during storage period. The total sugar content during storage have positive proportional trend (Desai *et al.*, (2012) [6] in mango pulp and Chand and Gehlot, 2006 [5] in Bael pulp.

Microbial count

Guava pulp was free from microbial spoilage during the storage up to 120 days and no mould and yeast growth was detected in any guava pulp samples. Microorganisms were inactivated in the guava pulp due to the effect of preservatives and also due to the effect of temperature (-20 ^{0}C).

Sensory Evaluation

The guava pulp was analyzed for colour, flavour, texture, taste and overall acceptability at an interval of 30 days for a whole period of 120 days. The sensory analysis was approved through Larmond scale (hedonic 9 point) by 15 judges panel having knowledge about sensory evaluation.

Table 1: Interaction effect of different varieties and preservatives on TSS, Titratable acidity, pH and Ascorbic acid content in guava pulp under cold storage conditions.

Treatment	TSS (^{O}Brix)			Titratable acidity (%)			pH			Ascorbic acid (mg 100g^{-1})		
	Storage period											
	30	60	120	30	60	120	30	60	120	30	60	120
Genotypes												
V_1	12.10	12.43	13.14	0.47	0.51	0.64	3.83	3.73	3.53	211.93	189.81	144.60
V_2	12.30	12.55	13.28	0.49	0.56	0.74	3.90	3.79	3.52	180.01	157.47	119.97
F - Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Non-Sig	Sig	Sig	Sig
SE (m)±	0.003	0.003	0.003	0.003	0.006	0.003	0.003	0.003	0.003	0.288	0.290	0.311
CD at 5 %	0.009	0.008	0.009	0.009	0.020	0.009	0.009	0.008	-	0.872	0.876	0.940
Preservatives												
P_1	12.18	12.47	13.25	0.47	0.51	0.67	3.89	3.77	3.49	202.78	178.14	138.78
P_2	12.34	12.66	13.44	0.45	0.51	0.64	3.94	3.81	3.61	213.15	190.71	151.11
P_3	12.16	12.51	13.25	0.49	0.54	0.72	3.85	3.74	3.51	190.84	168.36	124.90
P_4	12.11	12.33	12.91	0.50	0.57	0.74	3.79	3.71	3.49	177.12	157.35	114.34
F - Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m)±	0.004	0.004	0.004	0.004	0.009	0.004	0.004	0.004	0.004	0.408	0.410	0.440
CD at 5 %	0.013	0.012	0.017	0.004	0.009	0.004	0.012	0.012	0.012	1.234	1.239	1.329
Interaction (V×P)												
V_1P_1	12.09	12.48	13.19	0.46	0.47	0.62	3.87	3.75	3.51	218.07	194.64	151.61
V_1P_2	12.29	12.59	13.40	0.43	0.49	0.61	3.90	3.78	3.62	229.39	207.21	163.33
V_1P_3	12.00	12.37	13.08	0.48	0.52	0.64	3.82	3.71	3.49	209.28	185.78	139.81
V_1P_4	12.02	12.29	12.89	0.49	0.54	0.69	3.72	3.66	3.48	190.98	171.60	123.62
V_2P_1	12.27	12.45	13.31	0.48	0.55	0.71	3.91	3.79	3.47	187.48	161.64	125.95
V_2P_2	12.39	12.72	13.47	0.47	0.53	0.67	3.97	3.84	3.59	196.91	174.20	138.89
V_2P_3	12.32	12.65	13.42	0.49	0.56	0.79	3.87	3.77	3.52	172.39	150.94	109.99
V_2P_4	12.20	12.37	12.93	0.50	0.59	0.78	3.85	3.76	3.49	163.25	143.09	105.06
F - Test	Sig	Sig	Sig	Non-Sig	Non-Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m)±	0.006	0.006	0.006	0.006	0.013	0.006	0.006	0.005	0.006	0.577	0.580	0.622
CD at 5 %	0.018	0.017	0.017	-	-	0.017	0.018	0.016	0.017	1.75	1.753	1.880

Table 2: Interaction effect of different varieties and preservatives on Reducing, Non-reducing sugar and Total sugar content in guava pulp under cold storage conditions.

Treatment	Reducing sugar (%)			Non-reducing sugar (%)			Total sugar (%)		
	Storage period								
	30	60	120	30	60	120	30	60	120
Genotypes									
V_1	3.26	4.67	8.14	3.03	2.92	1.87	6.29	7.60	10.01
V_2	3.23	4.64	8.10	3.01	2.83	1.89	6.26	7.47	9.98
F - Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m)±	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
CD at 5 %	0.009	0.006	0.009	0.009	0.009	0.009	0.009	0.009	0.009
Preservatives									
P_1	3.21	4.63	8.12	3.15	2.96	1.96	6.35	7.59	10.06
P_2	3.33	4.72	8.23	3.14	3.00	1.96	6.47	7.72	10.18
P_3	3.27	4.67	8.19	2.92	2.80	1.73	6.19	7.46	9.91
P_4	3.18	4.60	7.96	2.91	2.74	1.88	6.09	7.38	9.84
F - Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m)±	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
CD at 5 %	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
Interaction (V×P)									
V_1P_1	3.22	4.65	8.12	3.17	2.99	1.98	6.39	7.64	10.10
V_1P_2	3.34	4.73	8.25	3.17	3.03	1.97	6.51	7.76	10.22
V_1P_3	3.29	4.68	8.20	2.88	2.84	1.72	6.17	7.52	9.92
V_1P_4	3.19	4.61	8.00	2.89	2.79	1.80	6.08	7.48	9.80
V_2P_1	3.20	4.60	8.09	3.12	2.93	1.93	6.31	7.54	10.02
V_2P_2	3.31	4.71	8.20	3.11	2.96	1.94	6.42	7.67	10.14
V_2P_3	3.25	4.65	8.18	2.95	2.75	1.73	6.20	7.40	9.90
V_2P_4	3.17	4.59	7.91	2.92	2.69	1.96	6.09	7.28	9.87
F - Test	Non-Sig	Non-Sig	Non-Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m)±	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
CD at 5 %	-	-	-	0.017	0.017	0.017	0.017	0.017	0.017

Table 3: Interaction effect of different varieties and preservatives on sensory parameters of guava pulp under cold storage conditions.

Treatment	Colour			Flavour			Texture			Taste			Overall acceptability		
	Storage period														
	30	60	120	30	60	120	30	60	120	30	60	120	30	60	120
V_1P_1	8.80	8.73	8.55	8.76	8.70	8.51	8.82	8.78	8.61	8.82	8.74	8.44	8.86	8.81	8.64
V_1P_2	8.81	8.76	8.57	8.79	8.73	8.53	8.84	8.79	8.63	8.83	8.76	8.46	8.87	8.83	8.66
V_1P_3	8.79	8.75	8.54	8.77	8.72	8.50	8.81	8.77	8.62	8.82	8.75	8.45	8.86	8.82	8.65
V_1P_4	8.78	8.70	8.53	8.74	8.71	8.49	8.80	8.74	8.61	8.81	8.71	8.41	8.84	8.79	8.60
V_2P_1	8.81	8.74	8.56	8.76	8.72	8.54	8.81	8.77	8.63	8.82	8.73	8.43	8.85	8.80	8.65
V_2P_2	8.82	8.77	8.59	8.79	8.74	8.55	8.84	8.80	8.65	8.84	8.78	8.48	8.88	8.84	8.68
V_2P_3	8.80	8.73	8.55	8.77	8.73	8.53	8.83	8.78	8.61	8.81	8.76	8.46	8.86	8.82	8.66
V_2P_4	8.79	8.72	8.54	8.75	8.72	8.52	8.80	8.75	8.60	8.83	8.70	8.40	8.84	8.80	8.59

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