

Processing and quality evaluation of guava squash

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Abstract

Guava (*Psidium guajava*), called as apple of the tropics, is one of the most common fruits in India. Excellent flavour and nutritive value aid to its great potential for preparation of beverages like squash and ready to serve (RTS). A study was undertaken to produce a stable and organoleptically preferred guava squash with proper suspension of fruit pulp supplementing the squash soluble dietary fibre with xanthan gum at five different concentrations (0.1 to 0.5%). Bottled guava squash of cv. Allahabad Safeda was prepared with 25% pulp, 40% total soluble solids (TSS), and 1% acidity with different concentration levels of xanthan gum, an exocellular polysaccharide produced by obligatory aerobic microorganism, *Xanthomonas campestris*. The stability of the products was studied by chemical and sensory evaluation of bottled squash during 180 days of storage. There were little changes in the quality parameters viz., TSS, pH, titratable acidity and ascorbic acid during storage. Non-enzymatic browning in guava squash increased with prolonged storage. Xanthan gum (0.5% W/W) gave stability to the product during 180 days of storage. Overall, acceptability was highest in pure guava squash containing 0.1% of xanthan gum, 40% of TSS and 1% of acidity during the 180 days of storage period.

Key words: Guava squash, xanthan gum, non-enzymatic browning, stability.

Introduction

Guava (*Psidium guajava* L.), called as apple of the tropics, is one of the most common fruits in India. It is a quite hardy, prolific bearer, remunerative fruit and thrives well on all types of soils from alluvial to lateritic but sensitive to water logging conditions (Bose *et al.*, 2001). It is commercially cultivated in gangetic alluvial zones of north and south Parganas, Nadia and Murshidabad district and lateritic zones of Paschim, Medinipur and Birbhum district, covering an area of nearly 8.27 thousand hectares (Anon., 2004). Guava bears fruit twice in a year –in rainy season and in winter. Farmers of West Bengal have developed technology to induce flowering at any time in the year. This facilitates availability of guava fruits throughout year.

Guava is plentiful during the rainy season and fruit disposal becomes a serious problem. Its utilization is very little in processing industry. Only jam and jelly are made from the fruits, but jam and jelly manufactured from guava pulp are not acceptable like other fruit products because of their gritty texture (Ramana Rao *et al.*, 1956). This gritty texture is due to the presence of corky cells in the pulp. Hence, big industries do not manufacture it. Excellent flavour and nutritive value of guava offers great potential for beverage preparation. The beverages are becoming popular in comparison to synthetic or aerated drink thus there is a need to develop processing technique for value added products such as squash and RTS.

Keeping the above facts in view, the present study was undertaken to utilize guava fruit pulp in the production of guava squash which would remain in suspension. To stabilize the product soluble dietary fibre in the form of xanthan gum at different concentrations was used and the changes in physico-chemical, sensory and microbiological attributes of the treatments during storage were evaluated.

Materials and methods

The present investigation was undertaken at the Department of Postharvest Technology, Bidhan Chandra Krishi Viswa Vidhyalaya, Mohanpur. Guava (cv. Allahabad Safeda) was procured from local Barajaguli market. Fruits with the same level of maturity, ripe and firm, free from blemishes and bruises were carefully selected for the study.

Washed guava fruits were sliced into small pieces (2-2.5 cm) with stainless steel knife while immersed in water. Fruit slices in water were heated at 74 -75°C for (2 - 5 min). Small pieces were mashed in a grinder with filtered water in proportions of 1: 3 by weight (guava slices / water, w/v). Pulp thus obtained was passed through a muslin cloth. Bottled guava squash was prepared with 25% pulp adjusted to 40 % TSS and 1% acidity (as citric acid) with varied levels of xanthan gum (Loha Chemie Pvt. Ltd. Mumbai, India) 0.1, 0.2, 0.3, 0.4, 0.5%, The hot syrup and fruit pulps / juice having calculated amount of xanthan gum were mixed on weight basis as outlined in recipes (Table 1). The guava squash treatments were heated to 85°C. For the final product, preservative KMS (Potassium metabisulphite) 350 ppm was added to prevent spoilage during the storage. The prepared squash was poured into pre-sterilized bottles of 200 mL capacity (sterilized at 25 lb/inch for 15 min) and sealed airtight. Then the product was sterilized in boiling water for 20 minutes and cooled immediately. Bottles were stored at room temperature (18-25°C) for further observation.

Prepared guava squash were analyzed for pH by Toshniwal digital pH meter (Model DI 707), total soluble solids by hand refractometer (Erma hand refractometer) and acidity by titration method. Ascorbic acid was determined by 2,6-dichlorophenol indophenol titration method (Ranganna, 1986) at every 30 days interval during 180 days of storage. Viscosity, one of the important

rheological characteristics of liquid foods was determined in fresh guava squash over a wide range of temperature (25-50°C) as well as at constant concentration (40 °Brix) by using the viscometer bath (Model No.- SVB, S.L. No.- S/01 Simco Brand, Kolkata, West Bengal) and capillary viscometer tube (Cannon Fenske viscometer). Non-enzymatic browning in the guava squash was measured in terms of OD (Optical density) at 440 nm by using a spectrophotometer (UV-VIS Dual beam Spectrophotometer, UVS-2700, Labomed, Inc.). Guava squash was evaluated at 180 days of storage for sensory attributes such as appearance, aroma and flavour, taste and overall acceptability by a panel of 8 judges by numerical scoring method (Amerine *et al.*, 1965). The prepared product was observed for mold growth by visual methods at monthly intervals throughout the storage period.

For data analysis, factorial completely randomized design was used. The data was analyzed and main interaction effects were presented (Sundararaj *et al.*, 1972). Significance of the treatment effect was tested using F-test.

Results and discussion

In general, total soluble solids of guava squash increased during storage (Table 2). This might be due to increase in total soluble sugars produced during hydrolysis of polysaccharides like starch, cellulose and pectin substances into simpler substances. Maximum increase in TSS (from 40 to 42.91° Brix) was noticed in treatment G₁ (25% of pulp, 40° Brix, 1% acidity, 0% of xanthan gum). Minimum increase in TSS was observed in the treatment G₆ (25% of pulp, 40° Brix, 1% acidity, 0.5% of xanthan gum) *i.e.*, from 40 to 40.09° Brix. Xanthan gum level and storage days (0, 30, 60, 90, 120, 150 & 180) interaction resulted in a significant ($P=0.05$) increase in total soluble solids throughout storage period. Maximum increase in TSS was noticed in the treatment G₁D₆ (25% of pulp, 40° Brix, 1% acidity, 0% of xanthan gum) *i.e.*, from 40 to 45.37° Brix. There was no change in TSS in the treatment G₆D₆ (25% of pulp, 40° Brix, 1% acidity, 0.5% of xanthan gum). Guava squash showed an increase in pH during storage. Maximum increase in pH was noticed in treatment G₁ (25% of pulp, 40° Brix, 1% acidity, 0% of xanthan gum) *i.e.*, from pH 2.74 to 3.49. The smallest change in pH was observed in treatment G₆ (25% of pulp, 40° Brix, 1% acidity, 0.5% of xanthan gum) *i.e.*, from pH 2.74 to 2.95. Xanthan gum level and storage time interaction significantly ($P=0.05$) affected the pH. Maximum increase in pH was observed in the treatment G₄D₆ (25% of pulp, 40° Brix, 1% acidity, 0.3% of xanthan gum at 180 days of storage period) *i.e.*, from pH 2.74 to 4.73. Minimum increase in pH was observed in the treatment G₂D₁ (25% of pulp, 40° Brix, 1% acidity, 0.1% of xanthan gum at 30 days of storage period) *i.e.*, from pH 2.74 to 2.78. The increase in pH of guava squash during storage could be attributed to acid hydrolysis of polysaccharides and non-reducing sugars to hexose sugars (reducing sugars) or complexing in the presence of metal ions as reported in aonla juice (Gajanana, 2002). Xanthan gum level and storage time interaction effect in changing the acidity were significant. Maximum reduction in acidity was noticed in the treatment G₃D₄ (25% of pulp, 40° Brix, 1% acidity, 0.4% of xanthan gum at 120 days of storage period) *i.e.*, from 1 to 0.63% minimum reduction in acidity from initial values (1%) was noticed in the treatment G₆D₃ (25% of pulp, 40° Brix, 1% acidity, 0.5% of xanthan gum) and maximum in G₆D₂. A declining trend in the

ascorbic acid content of guava squash was noticed during storage. The decline in ascorbic acid concentration could be due to thermal degradation during processing and subsequent oxidation in storage as it is very sensitive to heat, pressure treatment and light (Brock *et al.*, 1998). Xanthan gum level and storage days interaction effects in changing ascorbic acid content were significant throughout storage period. Maximum decrease in ascorbic acid was noticed in the treatment G₁D₆ (25% of pulp, 40° Brix, 1% acidity, 0% of xanthan gum at 180 days of storage period) *i.e.*, from 37.18 to 21.86 mg/100mL.

Minimum decrease in ascorbic acid was noticed in the treatment G₆D₁ (25% of pulp, 40° Brix, 1% acidity, 0.5% of xanthan gum at 30 days of storage period) *i.e.*, from 37.18 to 37.17mg/100mL. A linear increase in non-enzymatic browning of guava squash was noticed during the 180 days of storage period. This might be due to non-enzymatic reaction between organic acids and sugars or oxidization of phenols leading to development of brown pigments (Deka *et al.*, 2005). Maximum increase in non-enzymatic browning (NEB) was noticed in the treatment G₁D₆ (25% of pulp, 40° Brix, 1% acidity, 0% of xanthan gum at 180 days of storage period) *i.e.*, from 0.00 to 0.087 OD. Non-enzymatic browning was not observed in the treatment G₆D₁ (25% of pulp, 40° Brix, 1% acidity, 0.5% of xanthan gum at 30 days of storage).

Viscosity of the guava squash increased as concentration of xanthan gum increased. Maximum viscosity was observed in the treatment G₆ (25% of pulp, 40° Brix, 1% acidity, 0.5% of xanthan gum) *i.e.* from 0.137 to 2.037 pa-sec. (Table 2). There was significant decrease in viscosity as temperature increased at different levels of xanthan gum (Table 3). The reason is that the viscosity of liquids is due to intermolecular cohesion and this cohesion decreases with increases in temperature. Aroma and flavour were significantly influenced by xanthan gum levels in all treatments. Overall acceptability of guava squash was significantly higher at 0.1% of xanthan gum followed by 0.2% in terms of aroma flavour acceptance (Table 3). Guava squash prepared with different treatment combinations was found completely free from spoilage due to higher total soluble solids (40°Brix) and effective processing of the product. Settlement of pulp particles at the bottom of bottles was noticed in the treatments G₁ (25% of pulp, 40° Brix, 1% acidity, 0% of xanthan gum level) and G₂ (25% of pulp, 40° Brix, 1% acidity, 0.1% of xanthan gum). On reducing the percentage of xanthan gum from 0.5% (G₆) in the preliminary treatments to 0.1% (G₂) resulted in the separation of pulp particles and suspended at the bottom within 24 days of bottling. The addition of 0.2, 0.3, 0.4 and 0.5% of xanthan gum to guava squash treatments (G₃, G₄, G₅ and G₆) resulted in the stability of the suspension upto 180 days experimental storage at 18-25°C. Results indicate that addition of xanthan gum to bottled guava squash positively impart on the stability and acts as emulsifier to the product and also acts as dietary fibre which is helpful from consumers' point of view.

Table 1. Recipes for guava squash

Recipe	Pulp content (%)	TSS (°Brix)	Acidity (%)	Xanthan gum
G ₁	25	40	1	0
G ₂	25	40	1	0.1
G ₃	25	40	1	0.2
G ₄	25	40	1	0.3
G ₅	25	40	1	0.4
G ₆	25	40	1	0.5

Table 2. Influence of different levels of xanthan gum, storage period and their interaction on TSS, pH, acidity, ascorbic acid and OD (browning) in guava squash

Description	TSS (°Brix)	pH	Acidity (%)	Ascorbic acid (mg/100 mL)	OD at 440nm
Initial value	40.00	2.74	1.00	37.18	0.00
Xanthan gum (%)					
0.0 (G ₁)	42.91	3.49	0.80	27.05	0.053
0.1 (G ₂)	42.20	3.21	0.82	29.63	0.013
0.2 (G ₃)	42.18	3.16	0.83	29.70	0.010
0.3 (G ₄)	41.70	3.10	0.88	31.64	0.009
0.4 (G ₅)	40.67	3.10	0.88	34.83	0.002
0.5 (G ₆)	40.09	2.95	0.91	33.85	0.001
LSD (P=0.05)	0.08	0.03	0.03	0.84	0.002
Storage in days					
30 days (D ₁)	40.30	2.80	0.971	35.68	0.007
60 days (D ₂)	40.82	2.92	0.944	33.59	0.010
90 days (D ₃)	41.49	3.01	0.746	31.25	0.013
120 days (D ₄)	41.79	3.17	0.839	30.14	0.017
150 days (D ₅)	42.38	3.40	0.836	28.68	0.020
180 days (D ₆)	42.96	3.71	0.812	27.36	0.022
LSD (P=0.05)	0.08	0.03	0.033	0.84	0.002
Interaction					
G ₁ × D ₁	40.50	2.81	0.96	33.63	0.019
G ₁ × D ₂	41.44	2.88	0.94	29.30	0.030
G ₁ × D ₃	42.46	3.00	0.92	27.60	0.047
G ₁ × D ₄	43.16	3.13	0.89	26.46	0.060
G ₁ × D ₅	44.53	3.45	0.88	23.46	0.073
G ₁ × D ₆	45.37	3.71	0.85	21.86	0.087
G ₂ × D ₁	40.41	2.78	0.97	35.47	0.010
G ₂ × D ₂	40.97	2.82	0.94	33.93	0.010
G ₂ × D ₃	42.03	2.89	0.90	28.60	0.012
G ₂ × D ₄	42.58	3.14	0.86	27.63	0.013
G ₂ × D ₅	43.13	3.32	0.84	26.74	0.015
G ₂ × D ₆	44.06	3.67	0.80	25.43	0.018
G ₃ × D ₁	40.37	2.78	0.96	35.79	0.009
G ₃ × D ₂	41.00	2.83	0.93	33.80	0.007
G ₃ × D ₃	42.13	2.89	0.89	28.96	0.008
G ₃ × D ₄	42.53	3.14	0.87	27.70	0.012
G ₃ × D ₅	43.09	3.30	0.83	26.65	0.011
G ₃ × D ₆	44.00	3.66	0.80	25.30	0.013
G ₄ × D ₁	40.36	2.83	0.95	35.97	0.000
G ₄ × D ₂	40.86	3.02	0.89	33.38	0.007
G ₄ × D ₃	41.50	3.12	0.85	31.78	0.011
G ₄ × D ₄	41.96	3.37	0.81	30.65	0.011
G ₄ × D ₅	42.40	3.86	0.76	29.71	0.012
G ₄ × D ₆	43.10	4.73	0.74	28.37	0.013
G ₅ × D ₁	40.20	2.81	0.96	36.08	0.000
G ₅ × D ₂	40.30	2.98	0.96	36.95	0.000
G ₅ × D ₃	40.56	3.17	0.81	36.15	0.000
G ₅ × D ₄	40.63	3.30	0.63	35.23	0.003
G ₅ × D ₅	41.10	3.46	0.75	33.46	0.007
G ₅ × D ₆	41.26	3.53	0.70	31.11	0.000
G ₆ × D ₁	40.00	2.81	0.99	37.17	0.000
G ₆ × D ₂	40.36	3.00	0.99	34.18	0.003
G ₆ × D ₃	40.30	3.00	0.09	34.41	0.000
G ₆ × D ₄	39.86	2.93	0.96	33.17	0.000
G ₆ × D ₅	40.03	3.00	0.94	32.08	0.000
G ₆ × D ₆	40.00	2.96	0.96	32.11	0.000
LSD (P=0.05)	0.20	0.07	0.08	2.05	0.010

Table 3. Variation in viscosity and organoleptic characteristics with varied levels of xanthan gum at 4 levels of temperature at 180 days of storage in guava squash

Xanthan gum (%)	Viscosity (pa-sec)			Organoleptic scores			
	Temperature (°C)			Temperature (°C)			
	30	40	50	25	30	40	50
0.0 (G ₁)	0.207	0.173	0.030	1.28	1.23	1.75	1.00
0.1 (G ₂)	0.700	0.600	0.417	3.50	3.58	3.16	3.37
0.2 (G ₃)	1.197	0.897	0.700	3.52	3.30	2.50	3.12
0.3 (G ₄)	1.740	1.330	1.027	3.56	2.81	2.22	2.42
0.4 (G ₅)	1.950	0.560	1.200	3.61	2.61	1.73	2.13
0.5 (G ₆)	2.847	2.427	1.647	3.72	2.48	1.23	2.05
LSD (P=0.05)		0.031		0.23	0.32	0.23	0.30

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