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Processing and quality evaluation of blended guava watermelon squash

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Abstract

Guava fruit juices are pleasant when diluted with other tropical fruit juices due to its too acidic or strongly flavoured and less coloured nature, thus blending offers the opportunity to adjust sugar and acid ratios and eliminates some defects in juice quality or nutritional attributes by proper combination of juices and further adjustments in ingredients. Guava-watermelon squash at different ratio (50:50, 75:25, 25:75) of pulp blending level containing 40 °Brix TSS and 1% of acidity were prepared with incorporation of different concentrations of xanthan gum, an exocellular polysaccharide produced by obligately aerobic bacteria *Xanthomonas campestris,* to investigate the effect of different ingredients on the product quality and stability during 180 days of storage. There were little changes in quality parameters, TSS, pH, titratable acidity, ascorbic acid during the storage and 0.5% w/w of xanthan gum gave stability to the product during storage. Blended guava-watermelon squash (75:25) having 0.3% of xanthan gum, 40 °Brix TSS, 1% acidity showed highest overall acceptability during the storage period.

Key words: Blended guava-watermelon squash, blended fruit beverages, xanthan gum, non-enzymatic browning and stability.

Introduction

Guava (*Psidium guajava* L.), called as apple of tropics, is one of the most common fruits in India. In West Bengal, it is commercially cultivated near gangetic alluvial zone North & South 24 Parganas, Nadia, Murshidabad district and lateritic zone of Paschim Medinipur and Birbhum district covering an area of nearly 8.27 thousand ha (Anonymous, 2011). Guava is available in plenty during the rainy season and its disposal becomes a serious problem. Its utilization is very little in processing industry. Only jam, jelly is made from its fruits, but jam and jelly manufactured from guava pulp are not acceptable like other fruit products because of gritty texture. Hence, big industries do not manufacture it. Its excellent flavour and nutritive value have a great potential in beverage industry. Guava fruit juice is too acidic, strongly flavoured, less coloured thus its dilution with other tropical fruits such as watermelon to impart colour and flavour increase consumer acceptability. Blending juices by choosing the individual components at different levels have been suggested for acceptable product development (Huor *et al.*, 1980). Keeping the above facts in view, the present study was undertaken to evaluate physico-chemical, sensory and microbiological attributes of blended guava-watermelon squash supplemented with soluble dietary fibre in the form of xanthan gum at different concentrations during storage.

Materials and methods

Guava (*cv*. Allahabad Safeda) was procured from local Barajaguli market of Kolkata. Fruits with the same level of maturity, ripening and firmness, free from blemishes and bruises were carefully selected for the study. The ripe cremish white guava, cut into slices (2-2.5 cm), were allowed for heat treatment at 74-75 °C for (2-5 min) to inactivate enzymes which cause browning. The pulp obtained by mashing in a grinder with filtered water in proportions of 1:3 (guava slices/water, w/v) (water used for the heat treatment also used for the juice extraction) was passed through a muslin cloth. At this stage the total soluble solids were measured by using hand refractometer. Seedless pulp of watermelon (var. Arka Manik) fruits was used for juice extraction by mashing in grinder. The blended guava-watermelon squash was prepared by mixing calculated amounts of blended juice of guava and watermelon, sugar, citric acid, xanthan gum, preservative (KMS) and water. Squash from blended guava-watermelon fruits juice was adjusted with 25% pulp/juice, 40 % TSS and 1% acidity (as citric acid) with varied level of xanthan gum (0.1, 0.2, 0.3, 0.4, and 0.5%) as outlined in recipe (Table 1). Sugar syrup was prepared by heating the mixture of cane sugar, water and at boiling stage citric acid was added and boiled for 2-3 minutes to get consistent product.

The strength of sugar was determined with the help of hand refractometer. The final total soluble solids were adjusted by adding extra syrup. The prepared syrup was filtered through muslin cloth to remove impurities. Prior to use the pure xanthan gum (Loha Chemie Pvt. Ltd. Mumbai, India) was dispersed uniformly in water and kept aside for 60 minutes to accomplish hydration. The xanthan gum in the form of dispersion was added to the blended guava and watermelon juice. The hot syrup and fruit pulps/juice having calculated amount of xanthan gum were mixed on weight basis. The blended guava-watermelon squash treatments were heated to 85 °C and preservative KMS (potassium metabisulphite) 350 ppm was added to final product to prevent spoilage during the storage. The prepared blended guava-watermelon squash was poured into pre-sterilized bottles of 200 mL capacity and sealed airtight. Bottles were sterilized in boiling water for 20 min, cooled immediately and stored at room temperature (18-25 °C) for further observations.

Blended guava-watermelon squash were analyzed for pH with

Table 1. Recipes for blended guava-watermelon squash

Recipe	Blending levels (%) guava : watermelon	TSS (^{0}Brix)	Acidity (%)	Xanthungum levels (%)
B_1X_1	50 : 50	40	1	0
B_1X_2	50 : 50	40	1	0.1
B_1X_3	50 : 50	40	1	0.2
B_1X_4	50 : 50	40	1	0.3
B_1X_5	50 : 50	40	1	0.4
B_1X_6	50 : 50	40	1	0.5
B_2X_1	75 : 25	40	1	0
B_2X_2	75 : 25	40	1	0.1
B_2X_3	75 : 25	40	1	0.2
B_2X_4	75 : 25	40	1	0.3
B_2X_5	75 : 25	40	1	0.4
B_2X_6	75 : 25	40	1	0.5
B_3X_1	25 : 75	40	1	0
B_3X_2	25 : 75	40	1	0.1
B_3X_3	25 : 75	40	1	0.2
B_3X_4	25 : 75	40	1	0.3
B_3X_5	25 : 75	40	1	0.4
B_3X_6	25 : 75	40	1	0.5

Toshniwal digital pH meter (Model DI 707), total soluble solids with hand refractometer (Erma hand refractometer) and acidity by titration method. Ascorbic acid was determined by 2, 6-dichlorophenol indophenols titration method at every 30 days interval during 180 days of storage (Ranganna, 1986). The viscosity in blended Guava-watermelon squash was determined over a wide range of temperature (30-50 ^{o}C) as well as at constant concentration (40 ^{o}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) during the 180 days storage period (Ranganna, 1986). Blended guava-watermelon squash product 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. In this experiment, factorial completely randomized design (factorial CRD) was adopted. The data was analyzed and main interaction effects were presented (Sundararaj *et al.,* 1972). Six different combinations of xanthan gum under the CRD for guava squash examined for recipe standardization.

Results and discussion

Significant chemical changes were noticed in different guava-watermelon squash blending levels and interaction effect with the xanthan gum levels throughout storage period (Table 2). Maximum increase in total soluble solids (40 to 41.95 ^{o}Brix) was noticed in the blending level B_2 (75:25 pulp). This might be due to increase in total soluble sugars caused by hydrolysis of polysaccharides like starch, cellulose and pectin substances into simpler substances. Minimum increase (from 40-41.38 ^{o}Brix) in total soluble solids was noticed in the blending level B_3 (25:75 pulp). Changes in watermelon squash and interaction effect due to various xanthan gum and pulp levels have been recorded by Shankaraswamy and Banik (2012). Maximum changes in TSS (40-43.03 ^{o}Brix) was noticed in treatment X_1B_1. A minimum change in TSS (40-40.66 ^{o}Brix) and acidity (1-0.91%) was noticed in treatment X_6B_3 (0.5% of xanthan gum 25:75 levels of pulp (guava: watermelon). Interaction effect in different xanthan gum and blending levels during 180 days of storage period were significant in chemical changes (Table 3). Maximum changes in TSS (from 40-43.92 ^{o}Brix), acidity (1-0.63%) was noticed in treatment D_6B_2 (at 180 days with 75:25 levels of pulp (guava: watermelon) and minimum was observed in D_1B_2 (40-40.17 ^{o}Brix). Difference in the pulp level, xanthan gum levels, different storage period and their interaction were significant in changing

Table 2. Changes in TSS, pH, acidity, ascorbic acid at different levels of blended guava-watermelon squash

Blending levels (%)	TSS (^{o}Brix)		pH		Acidity (%)		Ascorbic acid (mg/100mL)	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
B_1(50 : 50)	40	41.91	3.38	3.76	1.0	0.884	19.4	15.07
B_2 (75 : 25)	40	41.95	3.14	3.37	1.0	0.783	30.9	20.56
B_3 (25 : 75)	40	41.38	3.59	3.75	1.0	0.882	12.8	7.84
LSD (*P*=0.05)	0.01		0.03		0.001		0.01	
Interaction [X (Xanthangum levels) x B (Blending levels)] during 180 days of storage period								
X1 B1	43.03		3.684		0.85		11.53	
X1 B2	42.85		3.518		0.72		17.48	
X1 B3	42.30		3.798		0.85		6.51	
X2 B1	42.10		3.565		0.84		13.28	
X2 B2	41.99		3.465		0.74		19.19	
X2 B3	41.62		3.794		0.86		7.25	
X3 B1	41.94		3.753		0.88		14.59	
X3 B2	41.94		3.347		0.75		19.66	
X3 B3	41.27		3.765		0.86		7.30	
X4 B1	41.73		3.711		0.89		16.80	
X4 B2	41.78		3.336		0.80		20.40	
X4 B3	41.27		3.724		0.88		7.87	
X5 B1	41.59		4.137		0.89		17.04	
X5 B2	42.12		3.323		0.93		21.77	
X5 B3	41.20		3.665		0.90		7.97	
X6 B1	41.08		3.756		0.93		17.16	
X6 B2	41.03		3.248		0.83		24.88	
X6 B3	40.66		3.676		0.91		10.11	
LSD (*P*=0.05)	0.06		0.019		0.01		0.05	

TSS. Maximum changes in TSS (from 40-45.30) was noticed in treatment $X_1D_6B_1$ (0% of xanthan gum, 50:50 levels of pulp (guava: watermelon), at 180 days of storage period). Minimum increase in TSS (from 40-40.03) was noticed in treatment $X_6D_1B_3$ (0.5% of xanthan gum, 25:75 levels of pulp (guava: watermelon). Similar results were observed in squash prepared from mango-papaya blended juice (Kalra *et al.*, 1991), kiwi fruit (Thakur and Barwal, 1998) and aonla (Reddy and Chikkasubbanna, 2008).

Table 3. Changes in TSS, PH, Acidity, Ascorbic acid content of Watermelon blended guava squash with 30, 60, 90, 120, 150, 180 days with 3 levels of blending

Interaction (Days x Blending)	TSS (°Brix)	pH	Acidity (%)	Ascorbic acid (mg/100 mL)
D1 B1	40.88	3.45	0.96	18.05
D1 B2	40.17	3.21	0.94	28.70
D1 B3	40.21	3.60	0.97	11.48
D2 B1	41.00	3.54	0.92	17.26
D2 B2	40.77	3.29	0.87	25.61
D2 B3	40.54	3.67	0.93	10.44
D3 B1	41.51	3.62	0.89	15.72
D3 B2	41.57	3.36	0.80	22.51
D3 B3	40.91	3.72	0.88	8.51
D4 B1	42.28	3.78	0.86	14.32
D4 B2	42.26	3.39	0.74	18.76
D4 B3	41.60	3.76	0.85	6.43
D5 B1	42.85	3.95	0.84	13.10
D5 B2	43.03	3.46	0.69	14.96
D5 B3	42.26	3.80	0.83	5.40
D6 B1	43.46	4.24	0.81	11.95
D6 B2	43.92	3.51	0.63	12.84
D6 B3	42.79	3.84	0.81	4.75
LSD (*P*=0.05)	0.06	0.02	0.02	0.05

Interaction (X x D x B) during 180 d of storage	TSS (°Brix)	pH	Acidity (%)	Ascorbic acid (mg/100 mL)
X1 D1 B1	40.80	3.47	0.95	17.18
X1 D1 B2	40.51	3.33	0.88	25.67
X1 D1 B3	40.51	3.65	0.97	10.61
X1 D2 B1	41.39	3.55	0.87	14.74
X1 D2 B2	41.29	3.41	0.80	23.10
X1 D2 B3	41.30	3.73	0.90	8.28
X1 D3 B1	42.12	3.62	0.85	12.33
X1 D3 B2	42.00	3.49	0.77	18.42
X1 D3 B3	42.00	3.78	0.84	6.88
X1 D4 B1	43.92	3.75	0.82	9.68
X1 D4 B2	43.51	3.56	0.67	15.01
X1 D4 B3	42.60	3.83	0.82	4.89
X1 D5 B1	44.67	3.82	0.80	8.16
X1 D5 B2	44.67	3.61	0.61	12.41
X1 D5 B3	43.36	3.88	0.79	4.42
X1 D6 B1	45.30	3.87	0.79	7.10
X1 D6 B2	45.10	3.68	0.58	10.30
X1 D6 B3	44.01	3.91	0.78	3.98
X2 D1 B1	40.28	3.45	0.95	18.03
X2 D1 B2	40.22	3.31	0.91	26.53
X2 D1 B3	40.23	3.65	0.95	11.56
X2 D2 B1	41.00	3.53	0.87	17.37
X2 D2 B2	40.76	3.38	0.84	25.72
X2 D2 B3	40.56	3.75	0.89	10.60
X2 D3 B1	41.86	3.55	0.86	14.36

Table 3 continued

X2 D3 B2	41.73	3.41	0.80	20.42
X2 D3 B3	40.96	3.81	0.88	7.55
X2 D4 B1	42.56	3.60	0.82	12.20
X2 D4 B2	41.96	3.43	0.68	17.46
X2 D4 B3	41.96	3.83	0.85	5.43
X2 D5 B1	43.06	3.61	0.79	9.20
X2 D5 B2	42.80	3.59	0.62	13.42
X2 D5 B3	42.86	3.84	0.81	4.48
X2 D6 B1	43.86	3.64	0.77	8.50
X2 D6 B2	44.49	3.64	0.60	11.60
X2 D6 B3	43.16	3.88	0.80	3.88
X3 D1 B1	40.49	3.42	0.96	17.96
X3 D1 B2	39.96	3.16	0.94	29.20
X3 D1 B3	40.20	3.60	0.96	11.26
X3 D2 B1	41.26	3.47	0.93	17.23
X3 D2 B2	40.50	3.27	0.86	24.83
X3 D2 B3	40.40	3.71	0.91	10.58
X3 D3 B1	41.56	3.53	0.88	15.35
X3 D3 B2	41.76	3.36	0.73	21.13
X3 D3 B3	40.70	3.75	0.85	7.58
X3 D4 B1	42.00	3.80	0.85	14.66
X3 D4 B2	42.43	3.37	0.74	17.60
X3 D4 B3	41.70	3.81	0.83	5.83
X3 D5 B1	42.86	3.98	0.83	12.56
X3 D5 B2	42.70	3.42	0.68	13.60
X3 D5 B3	42.00	3.84	0.83	4.51
X3 D6 B1	43.49	4.30	0.80	9.77
X3 D6 B2	44.30	3.47	0.58	11.62
X3 D6 B3	42.63	3.85	0.82	4.06
X4 D1 B1	40.38	3.43	0.96	18.61
X4 D1 B2	40.00	3.14	0.96	30.13
X4 D1 B3	40.06	3.58	0.99	11.73
X4 D2 B1	41.00	3.46	0.94	18.14
X4 D2 B2	40.56	3.26	0.94	24.86
X4 D2 B3	40.33	3.61	0.93	10.70
X4 D3 B1	41.40	3.51	0.90	16.54
X4 D3 B2	41.43	3.36	0.80	22.66
X4 D3 B3	40.86	3.70	0.89	9.15
X4 D4 B1	42.00	3.69	0.87	16.44
X4 D4 B2	42.00	3.37	0.77	17.86
X4 D4 B3	41.33	3.76	0.86	5.96
X4 D5 B1	42.53	3.92	0.84	16.06
X4 D5 B2	42.83	3.40	0.70	14.06
X4 D5 B3	42.26	3.81	0.83	4.88
X4 D6 B1	43.06	4.24	0.81	15.43
X4 D6 B2	43.86	3.46	0.63	12.80
X4 D6 B3	42.76	3.86	0.81	4.80
X5 D1 B1	40.29	3.48	0.97	18.33
X5 D1 B2	40.23	3.15	0.97	30.33
X5 D1 B3	40.23	3.55	0.97	11.83
X5 D2 B1	40.89	3.64	0.95	18.03
X5 D2 B2	41.16	3.26	0.89	26.56
X5 D2 B3	40.63	3.66	0.95	10.70
X5 D3 B1	41.10	3.76	0.90	18.56

Table 3 continued

X5 D3 B2	41.76	3.31	0.84	25.36
X5 D3 B3	40.73	3.68	0.91	9.24
X5 D4 B1	41.86	4.02	0.89	16.15
X5 D4 B2	42.70	3.36	0.79	18.86
X5 D4 B3	41.06	3.66	0.88	6.37
X5 D5 B1	42.36	4.49	0.85	16.10
X5 D5 B2	43.33	3.41	0.75	14.63
X5 D5 B3	42.00	3.66	0.85	4.87
X5 D6 B1	43.06	5.40	0.81	15.10
X5 D6 B2	43.56	3.42	0.74	14.86
X5 D6 B3	42.43	3.76	0.83	4.82
X6 D1 B1	40.10	3.43	0.97	18.70
X6 D1 B2	40.10	3.14	0.97	30.36
X6 D1 B3	40.03	3.57	0.98	11.86
X6 D2 B1	40.46	3.60	0.96	18.03
X6 D2 B2	40.36	3.17	0.91	28.56
X6 D2 B3	40.03	3.60	0.98	11.80
X6 D3 B1	41.00	3.75	0.95	17.16
X6 D3 B2	40.73	3.22	0.87	27.10
X6 D3 B3	40.23	3.64	0.91	10.66
X6 D4 B1	41.33	3.85	0.94	16.76
X6 D4 B2	40.96	3.26	0.8	25.80
X6 D4 B3	40.86	3.68	0.89	10.12
X6 D5 B1	41.63	3.88	0.91	16.50
X6 D5 B2	41.86	3.82	0.78	21.63
X6 D5 B3	41.06	3.78	0.88	9.26
X6 D6 B1	42.00	4.01	0.87	15.83
X6 D6 B2	42.20	3.36	0.66	15.86
X6 D6 B3	41.73	3.76	0.84	6.98
LSD (*P*=0.05)	0.15	0.05	0.02	0.11

Differences in pH were significant (*P*=0.05) with different pulp levels. Increasing trend of pH was noticed throughout storage period. Maximum increase (3.38- 3.76) in pH was noticed in the blending level B_1 (50: 50 pulp). Minimum changes (3.14 to 3.37) in pH was noticed in the blending level B_2 (75: 25 pulp) and in treatment $X_5D_5B_1$ (3.38-4.49). The increase in pH of guava-watermelon blended squash during storage could be attributed to acid hydrolysis of polysaccharides and non-reducing sugars to hexose sugars (reducing sugars) or complex formation in the presence of metal ions as reported in aonla juice (Gajanana, 2002). There was a declining trend in acidity of guava blended watermelon squash throughout storage period. Pulp levels and xanthan gum and storage period and there interaction effects were significant throughout storage period. Minimum changes in the acidity in the treatment $X_6D_1B_3$ (1 to 0.98) and D_1B_3 (1 to 0.97) was noticed, respectively. Difference in the pulp level, xanthan gum levels and at different storage period and their interaction were significant in changing ascorbic acid. Maximum loss in the ascorbic acid (30.9-20.56mg/100mL) was noticed in the treatment B_2 (75:25). Minimum changes in the ascorbic acid were noticed in the treatment B_1 (19.42-15.0mg/100mL) and X_6B_1 (19.42- 17.16 mg/100g) (Table 2). The decline in ascorbic acid concentration could be due to its thermal degradation during processing and subsequent oxidation in storage (Brock *et al.*, 1998). Similar observations were made in guava squash (Shankaraswamy and Banik, 2011), aonla squash (Reddy and Chikkasubbanna, 2008) and amla jam (Reddy and Chikkasubbanna, 2009). Increasing trend of viscosity observed in the blended guava-watermelon squash. Less incorporation of xanthan gum in 75:25 blending level gave maximum viscosity compare to other treatments. The maximum score for the aroma and flavour (3.07) and taste (2.50) with highest overall acceptability (2.08) was observed in the treatment B_2 (75:25) (Table 4). Results indicate that addition

Table 4. Organoleptic score and relative variation in viscosity of blended guava-watermelon squash

Blending level (%)	Aroma and flavor	Colour and appearance	Teste	Over all acceptability	Viscosity (Pa-sec)		
					30 °C	40 °C	50 °C
B_1(50 : 50)	2.69	1.28	1.89	1.72	2.760	3.570	2.283
B_2(75 : 25)	3.07	1.09	2.50	2.08	2.130	4.010	1.985
B_3 (25 : 75)	2.15	1.79	1.46	1.54	2.313	2.300	1.677
CD at 5%	0.15	0.11	0.12	0.11		0.015	
X_1B_1(50 : 50)	1.43	0.72	1.61	1.00	0.531	0.981	0.715
X_1B_2(75 : 25)	1.71	0.76	2.43	1.17	0.503	6.904	0.071
X_1B_3 (25 : 75)	1.18	0.83	1.31	0.90	0.353	0.384	0.003
X_2B_1(50 : 50)	2.10	1.18	2.13	2.17	1.073	1.928	0.961
X_2B_2(75 : 25)	3.16	1.06	3.05	3.11	0.947	1.242	0.832
X_2B_3 (25 : 75)	1.35	2.06	1.76	1.93	0.698	0.340	0.762
X_3B_1(50 : 50)	2.73	1.75	2.22	2.52	2.716	3.651	1.668
X_3B_2(75 : 25)	3.20	1.25	2.97	3.07	2.547	3.574	1.553
X_3B_3 (25 : 75)	2.25	2.16	1.71	2.31	2.361	2.673	1.423
X_4B_1(50 : 50)	3.05	1.53	2.13	1.97	3.012	3.977	2.674
X_4B_2(75 : 25)	3.32	1.18	2.70	2.22	2.877	2.520	2.423
X_4B_3 (25 : 75)	2.75	2.11	1.33	1.80	2.741	1.464	2.027
X_5B_1(50 : 50)	2.96	1.25	1.65	1.45	4.071	4.725	3.005
X_5B_2(75 : 25)	3.26	1.15	1.95	1.81	1.123	4.511	2.816
X_5B_3 (25 : 75)	3.28	1.81	1.36	1.26	3.367	4.262	2.321
X_6B_1(50 : 50)	3.58	1.27	1.57	1.20	5.158	6.161	4.677
X_6B_2(75 : 25)	3.76	1.16	1.91	1.12	4.780	5.307	4.214
X_6B_3 (25 : 75)	3.95	1.75	1.30	1.02	4.359	4.678	3.528
LSD (*P*=0.05)	0.36	0.28	0.29	0.27		0.037	

of xanthan gum 0.3% positively imparts stability and acts as emulsifier to the blended guava-watermelon squash. Squash prepared from 75:25 blending level was highly preferred thus it has added advantage in utilizing more guava fruits during the rainy season.

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