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Research Article
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Effect of Different Levels of Sucrose-Glucose Mixture on Overall Quality of Guava Bar

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Abstract

The effect of sucrose-glucose mixture was studied on the overall quality of guava bar stored at room temperature (25-30°C) during three months storage period. Different ratio of sucrose glucose mixture was used. All the treatments were analyzed for physicochemical characteristics and sensory (color, texture, taste and overall acceptability). The results showed that decreased were observed in water activity (from 0.68 to 0.62), moisture (from 18.59 to 14.43), pH (from 3.87 to 3.69) and ascorbic acid (from 3.87 to 3.69) color (from 7.67 to 5.63), texture (from 7.67 to 5.63), taste (from 7.42 to 5.37) and overall acceptability (from 7.53 to 5.48), while reducing sugar (from 14.16 to 14.41), titratable acidity (1.13 to 1.33), and total soluble solids (from 61.85 to 63.70) was increased. The overall results showed that treatment GL_2 followed by GL_5 were found adequate both physicochemical and sensory evaluation.

Keywords: Bar; Guava; Guar gum; Sucrose; Glucose

Introduction

Guava (*Psidium guajava* L.) belongs to the family Myrtaceae, characterized by 80 genera and 3000 species [1,2]. It has originated from Mexico to Peru [3]. In terms of area and production, guava is the fourth most important fruit after mango, banana and citrus [4]. In Pakistan, guava fruit stands at number three in terms of production, after mango and banana [5]. A guava fruit has a mass of 150-250 grams.

Fruit leather is an intermediate moisture food (IMF), also called as fruit roll, fruit bar or fruit sheet commercially, and developed by dehydration of fruit pastes into leathery sheet [6]. Fruit leathers are probably, originated from the times of Persian Empire. They are recognized with different names in different nations; “Qamar al deen” in Lebanon, Syria and other Arab countries,“Bastegh” or “Pastegh” in Armenia, “Pestil” in Turkey and “Fruit roll” or “Fruit leather” in the United States. In scientific literature, the last name, “Fruit leather” is mostly used. Fruit leather having water activity less than 0. 6 and moisture content of 8-15%. They contain acids and sugar naturally, while humectants are purposely added to minimize water activity and to provide softness even at lower moisture levels [7]. Guar gum is consider as one of the main gums. Guar gum is achieved from a legume crop. It is a complex carbohydrate, broadly grown in Pakistan and India and has very low price. Xanthan and Guar gums are widely used for the thickness of food products all over the food industries [8].

Materials and Methods

The research was conducted in the laboratory of the Department of Food Science and Technology, The University of Agriculture, Peshawar. Good quality fresh, mature and healthy guava was bought from the Peshawar local market and was transported to the laboratory. The diseased free fruit was selected and washed with water in order to remove dust, dirt and any other foreign material. The fruit was peeled, trimmed, cut and dipped in 1% citric acid to prevent oxidation. Then the fruit was blended in order to get the pulp. After that the treatments (20 °brix) were prepared. Each treatment were poured in stainless steel trays and kept in cabinet drier at 55°C. The treatments were GL_0 = Control, GL_1 = Guava pulp with sucrose + glucose (1:1) and guar gum (0.25%), GL_2 = Guava pulp with sucrose + glucose (7:3) and guar gum (0.25%), GL_3 = Guava pulp with sucrose + glucose (3:7) and guar gum (0.25%), GL_4 = Guava pulp with sucrose + glucose (10:0) and guar gum (0.25%), GL_5 = Guava pulp with sucrose + glucose (0:10) and guar gum (0.25%).

Packaging

The prepared bar was wrapped with aluminum foil and then packed in a transparent polythene bags.

Chemical analysis

Ascorbic acid: Ascorbic acid determination was done by the standard method as detailed in the AOAC [9] method no 967.21.

Titratable acidity: The titratable acidity was measured by the standard method of AOAC [9] method no 942.15.

pH: pH was measured by using the standard method of AOAC [9] method no 2005.02.

Total soluble solids: The total soluble solids (TSS) were determined by the standard methods of AOAC [9] method no 932.14 and 932.12, using Atago digital refractometer at room temperature.

Reducing sugar: Reducing sugars was determined by Lane and Eynon recommended procedure as explained in AOAC [9] method no 920.183.

Water activity (a_w): Water activity was measured by using Novasina RTD 502 apparatus (Novasina, Pfapfikkon, Switzerland).

Moisture (%): Moisture of the sample was determined by the standard method of AOAC [9] method no 925.45.

Total microbial count: The sample was analyzed for the total

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microbial count by the total plate count method as describe Dillello.

Sensory evaluation: The guava bar was sensory judged for taste, color, overall acceptability and texture by the panels of 10 judges. The evaluation was carried out by using 9 points hedonic scale of Larmond [10].

Statistical analysis

All the data concerning treatments and storage interval were statistically analyzed by means of completely Randomized Design (CRD) 2 Factorial and the means were separated by applying least significant difference (LSD) Test at 5% possibility level as defined by Steel and Torrie [11].

Results and Discussion

Chemical analysis

Water activity (a_w): Mean values for a_w reduced from 0.68 to 0.62 for the period of the storage. Highest mean values for treatments were perceived in GL_2 and GL_5 (0.66) followed by GL_3 and GL_4 (0.65), in compare lowest mean values were documented in GL_0 and GL_1 (0. 64). During the storage highest fall in aw was recorded in GL_0 (10.45%) followed by GL_1 (8.96), in contrast minimum fall was recorded in GL_3 (4.48) followed by GL_5 (7.35) (Table 1). The association of the added sugars and water through hydrogen bonding reduction was occurred in a_w. Invert sugar acts as bonding agent and the water passage at the product surface is slow. This action delays the creation of sugar recrystallization on the product surface for the duration of storage [12]. Low water activity value provides a margin of safety for the storage of acid foods at ambient temperatures, because it would not only prevent growth of pathogenic microorganism but also would strongly inhibit growth of non-pathogenic fungi and yeasts as well [13]. In a similar study, Babalola et al. [14] found a decrease in a_w during study of guava and pawpaw leather (from 0.64- 0.61), Huang and Hung [15] also reported a decrease in a_w during study of pear fruit leather(from 0.44-0.37) and Irwandi et al. [16] found a decrease in a_w during study of durian fruit leather from (0.597-0.573) respectively.

Moisture (%): The mean values for moisture decrease from 18.59 to 14.43 during storage. Highest mean values for treatments were observed in GL_0 (18.44) followed by GL_1 (16.46), in contrast lowest mean values were recorded in GL_2 (15.59) followed by GL_5 (15.80) and GL_4 (16.33). During storage highest fall in moisture content was recorded in GL_2 (30.53%) followed by GL_5 (28.45%), in compare minimum fall was observed in GL_0 (0.76%) followed by GL_1 (21.50%) (Table 2).There was a strong relationship between moisture content and a_w the higher the moisture content the higher the a_w. Similar observations were made on kiwifruit leather by Lodge [17] and jackfruit leather by Che Man and Taufik [18]. In a similar study, Huang and Hung [15] found a decrease in moisture during study of pear fruit leather (12.13-7.97) and Irwandi et al.[16] also observed a decrease in moisture during study of durian fruit leather (15.82-14.36) respectively.

Microbial count: The mean values for microbial count reduced from 13.33 × 10^1 to 5.17×10^1 cfu/g for the period of storage. Highest mean values for treatments were perceived in GL_1 (10.29×10^1) cfu/g followed by GL_4 (9.43×10^1), in contrast lowest mean values were recorded in GL_5 (7.71×10^1) cfu/g followed by GL_2 (8×10^1) cfu/g. During storage highest fall in microbial count was recorded in GL_2 (76.29×10^1 %) followed by GL_5 (69.23×10^1%), in compare minimum fall was observed in GL_0 (50×10^2) and GL_1 (50×10^1%) followed by GL_4 (57.14×10^1%) (Table 3). According to Troller [19,20], most of the microorganisms can barely survive a_w lower than 0.60. Similar result of microbial count was reported by Huang and Hung [15] the results of microbiological examine stated in forgoing studies [19]. Decrease of microorganism might be due to low water activity, low pH and low moisture content minimum water activity required for microbial growth [20], and its pH (3.8) was below the lower limit for bacterial growth (4.0), allowing only moulds and yeasts to grow [21]. Also, different preservation factors,

Treatments	Storage Interval (Days)								Mean
	0	15	30	45	60	75	90	% Decrease	
GL_0	0.66	0.66	0.65	0.63	0.62	0.61	0.60	10.45	0.63 e
GL_1	0.68	0.67	0.66	0.64	0.63	0.62	0.61	8.96	0.64d
GL_2	0.69	0.68	0.67	0.66	0.65	0.64	0.63	8.70	0.66 a
GL_3	0.67	0.66	0.66	0.65	0.65	0.64	0.64	4.48	0.65bc
GL_4	0.68	0.67	0.66	0.65	0.64	0.63	0.62	8.82	0.65 c
GL_5	0.68	0.67	0.67	0.66	0.65	0.64	0.63	7.35	0.66 ab
Mean	0.68 a	0.67b	0.66 c	0.65d	0.64 e	0.63 f	0.62 g		

Values having different alphabetical letters are significantly (P<0.05) not same
LSD at 5% level for treatments = 0.604
LSD at 5% level for intervals = 0.053

Table 1: Effect of storage period and treatments on water activity (a_w) of guava bar.

Treatment	Storage Interval								Mean
	0	15	30	45	60	75	90	%Decrease	
GL_0	18.53	18.50	18.47	18.44	18.41	18.39	18.39	0.76	18.45a
GL_1	18.97	18.45	17.59	16.47	15.21	14.54	13.99	26.26	16.46b
GL_2	18.30	17.59	16.76	15.39	14.61	13.81	12.71	30.53	15.59c
GL_3	18.90	18.00	17.46	16.71	15.51	14.41	13.84	26.79	16.40bc
GL_4	18.45	17.50	16.56	16.01	15.96	15.37	14.48	21.50	16.33bc
GL_5	18.39	17.05	16.43	15.83	15.17	14.57	13.16	28.45	15.80bc
Mean	18.59a	17.85ab	17.21bc	16.47cd	15.81de	15.18ef	14.43f		

Values having different alphabetical letters are significantly (P<0.05) not same
LSD at 5% level for treatments = 0.8495
LSD at 5% level for intervals = 0.9176

Table 2: Effect of storage period and treatments on (%) moisture of guava bar.

Treat	Storage Interval (Days)								Mean
	0	15	30	45	60	75	90	% Decrease	
GL_0	12×10^2	11×10^2	10×10^2	9×10^2	8×10^2	7×10^2	6×10^2	50.00×10^2	9.00×10^2 b
GL_1	14×10^1	12×10^1	9×10^1	8×10^1	7×10^1	6×10^1	5×10^1	50.00×10^1	10.29×10^1 a
GL_2	13×10^1	12×10^1	10×10^1	7×10^1	6×10^1	5×10^1	3×10^1	76.92×10^1	8.00×10^{1}cd
GL_3	13×10^1	10×10^1	9×10^1	7×10^1	6×10^1	5×10^1	4×10^1	64.29×10^1	8.71×10^{1}bc
GL_4	14×10^1	12×10^1	10×10^1	9×10^1	8×10^1	7×10^1	6×10^1	57.14×10^1	9.43×10^1 b
GL_5	15×10^1	13×10^1	11×10^1	10×10^1	9×10^1	8×10^1	7×10^1	69.23×10^1	7.71×10^{1}d
Mean	13.33×10^{1}a	11.67×10^1 a	9.83×10^{1}a	8.33×10^{1}a	7.33×10^{1}a	6.33×10^{1}a	5.17×10^{1}a		

Values having different alphabetical letters are significantly (P<0.05) not same
LSD at 5% level for treatments = 0.7239
LSD at 5% level for intervals = 0.7818

Table 3: Effect of storage period and treatments on Microbial load (cfu/g) of guava bar.

Treatments	Storage Interval (Days)								Mean
	0	15	30	45	60	75	90	% Increase	
GL_0	3.26	3.95	3.95	3.95	3.96	3.96	3.97	17.88	3.86f
GL_1	14.57	14.57	14.57	14.58	14.58	14.58	14.58	0.07	14.58e
GL_2	17.77	17.79	17.82	17.86	17.89	17.91	17.93	0.89	17.85a
GL_3	17.34	17.34	17.35	10.35	17.35	17.36	17.36	0.12	17.35b
GL_4	15.99	16.02	16.06	16.09	16.13	16.15	16.17	1.11	16.09d
GL_5	16.00	16.42	16.42	16.43	16.43	16.43	16.44	2.68	16.37c
Mean	14.16b	14.35a	14.36a	14.38a	14.39a	14.40a	14.41a		

Values having different alphabetical letters are significantly (P<0.05) not same
LSD at 5% level for treatments = 0.1174
LSD at 5% level for intervals = 0.1268

Table 4: Effect of storage period and treatments on (%) reducing sugar of guava bar.

Treatments	Storage Interval (Days)								Mean
	0	15	30	45	60	75	90	% Increase	
GL_0	14.00	14.40	14.70	15.00	15.20	15.40	15.70	13.93	14.91 f
GL_1	77.10	77.40	77.70	78.00	78.40	78.70	79.00	20.00	78.04 e
GL_2	78.50	78.90	79.20	79.50	79.80	80.10	80.40	14.53	79.49 a
GL_3	77.80	78.10	78.40	78.80	79.10	79.40	79.70	15.61	78.76 c
GL_4	77.40	77.80	78.10	78.50	78.80	79.20	79.50	14.89	78.47 d
GL_5	78.20	78.50	78.90	79.30	79.60	79.80	80.00	16.67	79.19 b
Mean	61.85 g	62.20 f	62.50 e	62.83 d	63.13 c	63.40 b	63.70 a		

Values having different alphabetical letters are significantly (P<0.05) not same

LSD at 5% level for treatments = 0.5031
LSD at 5% level for intervals = 0.5434

Table 5: Effect of storage period and treatments on TSS (°brix) of guava bar

such as pH and water activity, usually have not just an additive effect on food stability, but act synergistically to inhibit microbial growth [22].

Reducing sugar (%): The mean values for reducing sugar increased from 14.16 to 14.41 for the period of the storage. Highest mean values for treatments were perceived in GL_2 (17.85) followed by GL_3 (17.35), while the lowest mean values were recorded in GL_0 (3.86) followed by GL_1 (14.58). During storage the highest raise in reducing sugar was recorded in GL_0 (17.73%) followed by GL_5 (2.68%), while lowest raise was observed in GL_1 (0.07%) followed by GL_3 (0.12%) as shown in Table 4. Due to the transposition of non-reducing sugars into reducing sugars and the modification of polysaccharides to monosaccharide's the reducing sugar is increase. In a similar result, Sharma et al. [23] reported an increase in reducing sugar (from 43.1-49.8) and Phimpharian et al. [24] also found an increase in reducing sugar from (20.9 to 26.3) respectively. The increase in reducing sugars has also been observed during storage of mango leather by Rao and Roy [25]. Similar results have been record in sapota -papaya bar during 3 months of storage period [26] and in apricot - soy toffees [27].

Total soluble solids: The mean values for Total soluble solids increased from 61.85 to 63.70 for the period of storage. Extreme mean values for treatments were perceived in GL_2 (79.49) followed by GL_5 (79.19), but in contrast the deepest mean values were registered in GL_0 (14.91) followed by GL_1 (78.04). During storage the highest raise in TSS was recorded in GL_1 (20%) followed by GL_5 (16.67%), while lowest raise was observed in GL_0 (13.93%) followed by GL_2 (14.53%) (Table 5). The increase in TSS might be due to the renovation of starch and other insoluble carbohydrates into sugars and also due to the loss of moisture content that tends to increase total soluble solid. In a similar result, Phimpharian et al. [24] reported an increase in TSS (from 82.42-86.9).

Titratable acidity: Acidity is the quantity of shelf life of the product. Titrable acidity studied to confirm physico-chemical changes during preparation [28] and during storage [29]. The mean values for Titratable acidity increased from 1.13 to 1.33 for the period of storage. Best mean values for treatments were perceived in GL_2 (1.45) followed by GL_5 (1.42), but in contrast the lowest mean values were listed in GL_0

(1. 30) followed by GL_1 (1. 36). For the period of storage the highest raise in acidity was recorded in GL_2 (15.38%) followed by GL_4 (14.77%), while deepest raise was perceived in GL_0 (19.47%) followed by GL_5 (12.50%) (Table 6). The increase in acidity might be due to development of acidic substances by the degradation of pectic bodies or breakdown and also attributed to hydrolysis of polysaccharides and non-reducing sugars through utilization of acids for converting them to hexose sugar. Rao and Roy [25] found an increase in acidity during storage of mango sheet (from 0.3-0.75). Manu et al. [30] noticed increase in acidity during storage of mango leather (from 0.37 and 0.44). Similarly Jain and Nema [31] observed an increase in acidity during study of guava leather (from 0.42-0.48) respectively. Acidiy of guava fruit bar increased while pH decreased during storage as per the study result of Gowda et al.

pH: The mean values for pH reduced from 3.87 to 3.69 for the period of storage. Highest mean values for treatments were perceived in GL_2 (3.87) followed by GL_5 (3.79) and GL3 (3.78), in contrast lowest mean values were noted in GL_0 (3. 75) followed by GL_1 (3.76) and GL_4 (3.77). During storage highest fall in pH was recorded in GL_3 (5.40%) followed by GL_5 (5.04%), in compare minimum fall was observed in GL_2 (4.13%) followed by GL_4 (4.29%) (Table 7). The changes in pH values might be due to increase in acidity and also due to the other chemical that occur during storage interval. Phimpharian et al. [24] noticed a reduction in pH values during storage of pineapple leather (from 3.6-3.8). Azeredo et al. [32] observed a decrease in pH values during storage of mango leathers (from 3.8-3.5). Similarly Natalia et al. [33] also observed a decrease in pH values during study of apple leather (from 3.50-3.30) respectively.

Ascorbic acid (Vit. C): Fruits and vegetables are important sources of ascorbic acid. The ascorbic acid content decreased during storage due to oxidation of ascorbic acid to dehyro ascorbic acid. Hence, vitamin C assessment was found out during the storage period. The mean values for ascorbic acid decreased from 92.34 to 74.42 for the period of storage. Supreme mean values for treatments were observed in GL_2 (84.78) followed by GL_5 (83.77), but in difference the deepest mean values were registered in GL_0 (78.60) followed by GL_1 (82.50). During storage the highest raise in ascorbic acid was recorded in GL_0 (21.47%) followed

Treatments	Storage Interval (Days)								Mean
	Initial	15	30	45	60	75	90	% Increase	
GL_0	1.22	1.24	1.27	1.30	1.33	1.36	1.39	12.23	1.30 f
GL_1	1.24	1.29	1.33	1.36	1.39	1.43	1.46	15.07	1.36 e
GL_2	1.36	1.39	1.42	1.45	1.48	1.51	1.54	11.69	1.45 a
GL_3	1.32	1.36	1.38	1.41	1.44	1.47	1.50	12.00	1.41 c
GL_4	1.27	1.30	1.34	1.38	1.41	1.45	1.49	14.77	1.38 d
GL_5	1.33	1.35	1.39	1.42	1.46	1.49	1.52	12.50	1.42 b
Mean	1.13g	1.17f	1.21e	1.24d	1.27 c	1.30 b	1.33 a		

Values having different alphabetical letters are significantly (P<0.05) not same
LSD at 5% level for treatments = 0.206
LSD at 5% level for intervals = 0.943

Table 6: Effect of storage period and treatments on (%) Titratable acidity of guava bar.

Treatments	Storage Interval (Days)								Mean
	0	15	30	45	60	75	90	% Decrease	
GL_0	3.84	3.81	3.78	3.75	3.73	3.70	3.67	4.43	3.75 d
GL_1	3.86	3.82	3.79	3.77	3.74	3.70	3.67	5.03	3.76 c
GL_2	3.87	3.85	3.83	3.80	3.77	3.74	3.71	4.13	3.80 a
GL_3	3.89	3.84	3.82	3.78	3.75	3.72	3.68	5.40	3.78 b
GL_4	3.85	3.83	3.80	3.77	3.75	3.71	3.69	4.29	3.77 c
GL_5	3.89	3.86	3.82	3.79	3.76	3.72	3.69	5.04	3.79 ab
Mean	3.87 a	3.84 b	3.81 c	3.78 d	3.76 e	3.72 f	3.69 g		

Values having different alphabetical letters are significantly (P<0.05) not same
LSD at 5% level for treatments = 0.242
LSD at 5% level for intervals = 0.902

Table 7: Effect of storage period and treatments on pH of guava bar.

Treatments	Storage Interval (Days)								Mean
	0	15	30	45	60	75	90	% Decrease	
GL_0	90.40	85.00	79.50	77.00	75.30	72.00	71.00	21.47	78.60 d
GL_1	92.00	89.00	85.50	82.50	78.50	76.50	73.50	20.11	82.50 c
GL_2	92.33	90.50	87.50	85.00	81.33	80.00	76.79	16.83	84.78 a
GL_3	93.50	88.00	85.83	81.83	79.82	77.23	75.83	18.90	83.15bc
GL_4	92.67	87.83	84.83	81.57	79.57	77.56	74.56	19.54	82.66 c
GL_5	93.17	89.99	85.79	82.82	80.87	78.87	74.87	19.64	83.77 b
Mean	92.34 a	88.39 b	84.82 c	81.79 d	79.23 e	77.03 f	74.42 g		

Values having different alphabetical letters are significantly (P<0.05) not same
LSD at 5% level for treatments = 0.9600
LSD at 5% level for intervals = 1.0369

Table 8: Effect of storage period and treatments on Ascorbic acid (mg/100g) of guava bar.

by GL_1 (20.11%), while lowest raise was observed in GL_2 (16.83%) followed by GL_3 (18.93%) (Table 8). Temperature has a major effect on the rate of loss of ascorbic acid. Losses of ascorbic acid were increased with the increase in temperature [34]. The ascorbic acid content decreased during storage [35]. Loss of ascorbic acid might be due to its oxidation to dehydro ascorbic acid followed by more degradation to 2, 3 - diketogulonic acid and finally to furfural complexes which go in browning reactions Sharma et al. [23]. Sharma et al. [23] noticed loss of ascorbic acid during study of apricot fruit (from 9.5-8.6). Jain and Nema [31] noticed loss of ascorbic acid during study of guava leather (176.27-104.87mg/g) and Ayshaye et al. [36] found a decrease in ascorbic acid during storage of pawpaw (from 83.33- 74.70 and guava leather (260.0-237.0) respectively. Loss of ascorbic acid has earlier been reported in mango leather during of 3 months storage by Rao and Roy [25]. Similar results have been reported by Sreemathi et al. [26] in sapota -papaya bar during 3 months of storage.

Sensory evaluation

Color: Initially the mean score of judges for color of guava bar of GL_0 to GL_5 was 6, 8, 8, 8, 8 and 8 which was gradually decrease to 3.5, 6.1, 6.5, 5.9, 5.8 and 6. 0 similarly for the period of storage. The mean values for intervals were significantly (P<0.05) intensified from 7.67 to 5. 63 for the period of storage. Supreme mean values for treatments were perceived in GL_2 (7.2571) 5.8 and 6. 0 similarly for the period of storage. The mean values for intervals were significantly (P<0.05) intensified from 7.67 to 5. 63 for the period of storage. Supreme mean values for treatments were perceived in GL_2 (7.2571) followed by GL_1 (7. 0857), but in contrast the lowest mean values were listed in GL_0 (4.7000) followed by GL_4 (6. 9143) [37-39]. For the period of storage the highest fall in color was recorded in GL_0 (41.67%) followed by GL_1 (27.50%), while lowest fall was observed in GL_2 (18.75%) followed by GL_5 (23.75%) (Table 9). A decrease in color might be due to browning reaction (millard) that occure during heating process in the drier. In a similar study, Jain and Nema [31] reported loss of color during storage of guava leather (7.10-6.16). Naz [39] also observed a decrease in color during her study (from 6-5) and Babalola et al. [14] (from 6.8-5.2) respectively.

Texture: Originally the mean score of juries for texture of guava bar of GL_0 to GL_5 was 5, 8, 8, 8, 8 and 8 which was progressively reduced to 3.1, 5. 6, 6.5, 5.9, 5. 7 and 6 correspondingly for the period of storage. The mean values for intervals were significantly (P<0.05) intensified from 7.67 to 5. 63 for the period of storage. Maximum mean values for treatments were perceived in GL_2 (7.2286) followed by GL_1 (7. 0286), but in contrast the deepest mean values were listed in GL_0 (3.9714) followed by GL_4 (6.7000). During storage the highest fall in texture was recorded in GL_0 (38.00%) followed by GL_1 (30.00%), while lowest fall was observed in GL_2 (18.75%) followed by GL_5 (25.00%) (Table 10). The texture of fruit leathers is mostly affected by their moisture content and drying temperatures by Che-man et al. [39]. High temperatures and long drying times are related with lower moisture content and rigid texture. Differences in texture of leathers might also be due to variations in genetic makeup of the fruit, rate of water immersion from the surroundings and protein content of the fruit amongst others by Babalola et al. [39]. The texture of fruit leather is also affected by the addition of sugar, which is occasionally completed in order to recover the flavor of the leather by Jain and Nema [31]. Similar result of texture was reported by Naz [37] (from 7-6).

Taste: Initially the mean score of juries for taste of guava bar of GL_0 to GL_5 was 4.5, 8, 8, 8, 8 and 8which was gradually decrease to 2.50, 5.60, 6.30, 5.90, 5.70 and 6.20 similarly for the period of storage. The mean values for intervals were significantly (P<0.05) intensified from 7.42 to 5. 37 for the period of storage. Supreme mean values for treatments were perceived in GL_2 and GL_5 (7.1143) followed by GL_1 (6.9429), but

Treatments	Storage Interval (Days)								Mean
	0	15	30	45	60	75	90	% Decrease	
GL_0	6	5.6	5.1	4.7	4.2	3.8	3.5	41.67	4.70 d
GL_1	8	7.6	7.2	6.9	6.6	6.3	5.8	27.50	6.91 c
GL_2	8	7.8	7.5	7.2	7	6.8	6.5	18.75	7.26 a
GL_3	8	7.7	7.4	7.1	6.7	6.2	6	25.00	7.01bc
GL_4	8	7.6	7.3	7	6.8	6.4	5.9	26.25	7.00bc
GL_5	8	7.7	7.4	7.1	6.8	6.5	6.1	23.75	7.09 b
Mean	7.67 a	7.33 b	6.98 c	6.67 d	6.35 e	6.00 f	5.63 g		

Values having different alphabetical letters are significantly (P<0.05) not same
LSD at 5% level for treatments = 0.1518
LSD at 5% level for intervals = 0.1640

Table 9: Effect of storage period and treatments on color of guava bar.

Treatments	Storage Interval (Days)								Mean
	0	15	30	45	60	75	90	% Decrease	
GL_0	5	4.6	4.1	3.9	3.7	3.4	3.1	38.00	3.97 d
GL_1	8	7.5	7.1	6.6	6.2	5.9	5.6	30.00	6.70 c
GL_2	8	7.7	7.5	7.2	7	6.7	6.5	18.75	7.23 a
GL_3	8	7.7	7.3	7	6.7	6.3	5.9	26.25	6.99 b
GL_4	8	7.6	7.1	6.7	6.3	6	5.7	28.75	6.77 c
GL_5	8	7.6	7.3	7.1	6.8	6.4	6	25.00	7.03 b
Mean	7.40 a	7.02 b	6.62 c	6.28 d	5.98 e	5.66 f	5.36 g		

Values having different alphabetical letters are significantly (P<0.05) not same
LSD at 5% level for treatments = 0.1519
LSD at 5% level for intervals = 0.1641

Table 10: Effect of storage period and treatments on texture of guava bar.

Treatments	Storage Interval (Days)								Mean
	0	15	30	45	60	75	90	% Decrease	
GL_0	4.50	4.10	3.70	3.50	3.20	2.90	2.50	44.44	3.49 d
GL_1	8.00	7.40	7.10	6.70	6.30	5.90	5.60	30.00	6.71 c
GL_2	8.00	7.70	7.40	7.10	6.80	6.50	6.30	21.25	7.11 a
GL_3	8.00	7.60	7.20	6.90	6.70	6.30	5.90	26.25	6.94 b
GL_4	8.00	7.50	7.10	6.80	6.40	6.00	5.70	28.75	6.79 c
GL_5	8.00	7.70	7.40	7.10	6.80	6.60	6.20	22.50	7.11 a
Mean	7.42 a	7.00 b	6.65 c	6.35 d	6.03 e	5.70 f	5.37 g		

Values having different alphabetical letters are significantly ($P<0.05$) not same
LSD at 5% level for treatments = 0.1134
LSD at 5% level for intervals = 0.1225

Table 11: Effect of storage period and treatments on taste of guava bar.

Treatments	Storage Interval (Days)								Mean
	0	15	30	45	60	75	90	% Decrease	
GL_0	5.2	4.8	4.3	4	3.7	3.4	3	42.31	4.06 d
GL_1	8	7.5	7.1	6.7	6.4	6	5.7	28.75	6.77 c
GL_2	8	7.7	7.5	7.2	6.9	6.7	6.4	20.00	7.20 a
GL_3	8	7.6	7.3	7	6.8	6.4	6	25.00	7.01 b
GL_4	8	7.6	7.2	6.8	6.5	6.1	5.8	27.50	6.86 c
GL_5	8	7.7	7.4	7.1	6.7	6.4	6	25.00	7.04 b
Mean	7.53 a	7.15 b	6.80 c	6.47 d	6.17 e	5.83 f	5.48 g		

Values having different alphabetical letters are significantly ($P<0.05$) not same
LSD at 5% level for treatments = 0.1118
LSD at 5% level for intervals = 0.1208

Table 12: Effect of storage period and treatments on overall acceptability of guava bar.

in contrast the deepest mean values were registered in GL_0 (3.4857) followed by GL_4 (6.7143). During storage the highest fall in taste was recorded in GL_0 (44.44%) followed by GL_1 (30.00%), while lowest fall was observed in GL_2 (21.25%) followed by GL_5 (22.50%) (Table 11). Taste and smell perceptions noted when food is taken. The overall flavor impression is the result of taste perceived by the taste buds in the mouth and the aromatic conpounds detected by the epithelium in the olfactory organ in the nose. Jain and Nema [31] recorded a decrease in taste during study of guava leather (from 6.19-6.02), Okilya et al. [38] also found a decrease in taste (from 6.63-4.33) respectively.

Overall acceptability: Primarily the mean score of juries for overall acceptability of guava bar of GL_0 to GL_5 was 5.2, 8, 8, 8, 8 and 8which was gradually decrease to 3, 5.7, 6.4, 6, 5.8 and 6 similarly for the period of storage. The mean values for intervals were significantly ($P<0.05$) intensified from 7.53 to 5. 48 for the period of storage. Supreme mean values for treatments were perceived in GL_2 (7.20) followed by GL_5 (7. 04), but in contrast the deepest mean values were listed in GL_0 (4. 06) followed by GL_1 (6.77). During storage the highest fall in overall acceptability was recorded in GL_0 (42.31%) followed by GL_1 (28.75%), while lowest fall was observed in GL_2 (20.00%) followed by GL_5 and GL_3 (25.00%) (Table 12). Overall acceptability generally related to all sensory attributes. It is stated that the suitability of fruits and vegetables is influenced by their aroma by Karmas and Harris [39]. Sharma et al. [23] noticed a decrease in overall acceptability during storage of apricot fruit bar (from7.8-7.2) respectively.

Conclusion and Recommendations

In present study, guava bar was prepared by using different level of sucrose glucose mixture with guar gum. The samples were analyzed for physicochemical, microbiologically and sensory. From this study, physic chemically the samples GL_2 prepared by sucrose: glucose (7:3) followed by GL_5 prepared by sucrose (10: 0) showed best result, while GL_0 prepared by guava pulp and followed by GL_1 prepared by sucrose: glucose (50: 50) showed lowest result. Sensory and microbiologically GL_2 followed by GL_5 showed good result, while GL_0 followed by GL_1 showed lowest result [40].

Recommendations

1. Study should be carried out in the effect of different packaging materials with different temperature.

2. Study the effect of different drying methods with different temperature.

3. Further study should be carried out that maintains color clarity.

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