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Effect of different concentrations of sugar and citric acid on storage quality of guava fruit bar

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Abstract
The results of present investigation entitled "Effect of different concentrations of sugar and citric acid on storage quality of guava fruit bar", following conclusions could be drawn. The increase in TSS, acidity, reducing sugars, non reducing sugars and total sugars of guava fruit bar were observed during storage. Whereas, p^H, TSS acid ratio, ascorbic acid, phosphorus and calcium were decreased during storage. The guava fruit bar prepared by using guava pulp mixed with 50 per cent sugar and 2 per cent citric acid and stored at ambient storage, secured the highest score in colour, flavour, taste and overall acceptability as compared to other recipes at 120th day of storage.

Keywords: Guava pulp, sugar, citric acid, storage

Introduction
Guava (*Psidium guajava* L.) is a fruit of sweet aroma with pleasant sour taste and it is claimed to be the fourth most important fruit in terms of area and production after mango, banana and citrus. It belongs to family Myrtaceae and have chromosome no. n=11. It is native to the tropical America stretching from Mexico to Peru. It has been adopted in India so well that it appeared to be an almost Indian fruit.
Guava is normally consumed fresh as dessert fruit as it is pleasantly sweet and refreshing in flavour. The whole fruit is edible along with skin. It is considered as one of the most delicious and luscious fruit. Excellent salad, jelly, cheese, canned fruit, RTS, nectar, squash, ice cream and toffees can be made from guava fruit (Jain and Asati, 2004) [4]. There has been a greater increase in the production rate of these fruits over the years, and this may be due to their increased consumption pattern in the tropics (FAO, 1982).
Guava are perishable fruit and are available as seasonal surpluses during certain parts of the year in different region and are wasted in large quantities due to absence of facilities and know-how for proper handling, distribution, marketing, and storage. Further more massive amounts of perishable fruits produced during a particular season results in glut in the market and become scarce during other seasons. Fruits for want of simple technologies of processing, preservation and transport to a various places of need, have a suffered post-harvest losses, estimated to nearly 35%. Only 1% of the total fruits and vegetables produced are processed in the 3000 food industries (Das, 1991) [3].
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 toffee can be made from guava fruit (Jain and Asati, 2004) [4]. There has been a great increase in the production rate of these fruits over the years, and this might be due to their increased consumption pattern in the tropics.
Dehydrated fruit processing is gaining importance 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) [15].
Jellies, fruit bar and preserve are manufactured as important fruit products in industries and based upon the high solids-high acid principle. In addition to the pleasing taste of such preserved fruits, they posses substantial nutritive value also. Realizing the importance of fruit as a cheaper, highly nutritious and because of perishable nature and seasonally available it was decided to make a preserved products, for human consumption throughout the year. Fruit bar is a nutritional product, has a chewy texture similar to dried raisins and is a good source of

dietary fibre and natural sugars. Thus, study will be planned keeping in view the nutritional importance of guava, to utilize them by preserving as fruit bar.

Material and Method

The experiment entitled "Effect of different concentrations of sugar and citric acid on storage quality of guava fruit bar" was carried out during the year 2016-2017 at Post Harvest Technology Laboratory, Department of Horticulture, School of Agricultural Science, G H Raisoni University, Saikheda, Chhindwara, MP The experiment was laid out in square design with nine treatments comprising of Manganese sulphate and Ferrous sulphate with the different concentration having treatments T1-Guava pulp with 30% sugar + 1.5% citric acid, T2-Guava pulp with 30%sugar +2.0% citric acid, T3-Guava pulp with 40%sugar +1.5% citric acid, T4-Guava pulp with 40%sugar +2.0% citric acid, T5-Guava pulp with 50%sugar +1.5% citric acid, T6-Guava pulp with 50%sugar +2.0% citric acid, T7-Guava pulp with 60%sugar +1.5% citric acid, T8-Guava pulp with 60%sugar +2.0% citric acid, T9-Guava pulp with 70%sugar +1.5% citric acid, T10-Guava pulp with 70%sugar +2.0% citric acid The field experiment was completed with three replications. Periodical observations were taken up with different growth stages. The experimental data on observations were statistically analyzed by adopting the procedure of Panse and Sukhatme7. The critical difference was calculated at five per cent probability level to draw statistical calculations.

Result and discussion

P^H during 120 day of storage was noticed when guava fruit bar was prepared by using guava pulp with 50ercent sugar and 2 percent citric acid. The recipe was next in order in this regard was T_8 (Guava pulp with 60% sugar + 2% citric acid) and T_5 (Guava pulp with 50% sugar + 1.5% citric acid). However, significantly maximum change (0.44) was noticed in T_1 (Guava fruit pulp with 30% sugar + 1.5% citric acid) followed by treatment T_2 (Guava fruit pulp with 30% sugar +2% citric acid) and T_3 (Guava fruit pulp with 40% sugar +1.5% citric acid). From the above result it is observed in general that, there was continuous decrease in p^H of guava fruit bar during storage. The decrease in p^H of guava fruit bar during the storage was might be due to increase in acidity during storage. The results mentioned above are in conformity with the findings of various research work. Similar decreasing trends of p^H and increasing acidity were reported during the storage period of guava leather by Sandhu *et al*. (2001) [14]. Phimpharian *et al*. (2011) [10] noticed a reduction in pH values during storage of pineapple leather. Safdar *et al*. (2014) [13] made investigation on quality of guava leather as influenced by storage period and packing materials and they reported gradual decrease in p^H, Similar decreasing trend of p^H was observed during storage of guava fruit bar by Shakoor *et al*. (2015) [16, 17].

Minimum total increase (0.71°B) in total soluble solids during 120 days of storage was noticed when guava fruit bar was prepared by using guava pulp with 50 percent sugar and 2 percent citric acid. The recipe found next in order in this regard was T_8 (Guava pulp with 60% sugar + 2% citric acid). However, maximum change (1.72°B) was noticed in treatment T_1 (Guava pulp with 30% sugar + 1.5% citric acid) Followed by treatment T_2 (Guava pulp with 30% sugar + 2% citric acid) and treatment T_3 (Guava fruit pulp with 40% sugar +1.5% citric acid). From the above result it is observed in general that, there was progressive increase in TSS of guava fruit bar during storage period, which 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 solids. The result mentioned above are conformity with the findings of various research workers. Sandhu *et al*. (2001) [14] noticed that guava leather when stored for 3 months, the TSS of the leather increased with increase of storage period. Jain and Nema (2007) [5] observed that, the pulp with more sugar significantly increased the TSS in the guava leather. Phimpharian *et al*. (2011) [10] reported an increase in TSS of pineapple leather. Khadatar (2012) [6] prepared jackfruit bar are reported that the TSS content of bar increased numerically from 65.99° B at the time of preparation to 67.33°B after 60 days of storage. Kuchi *et al*. (2014) [7]. reported that TSS, were increased in the jelly bar stored in ambient condition. Safdar *et al*. (2014) [13] also reported gradual increase in TSS during storage period in guava leather.

Minimum total increase (0.22%) in total titratable acidity during 120 days of storage was noticed when guava fruit bar was prepared by using guava pulp with 50 percent sugar and 2 percent citric acid. The recipe found next in order in this regard was T_8 (Guava pulp with 60% sugar +2.0% citric acid). However, maximum change (0.66%) was noticed in treatment T_1 (guava pulp with 30% sugar + 1.5% citric acid). Followed by treatment T_2 (Guava fruit pulp with 30% sugar + 2% citric acid) and treatment T_3 (Guava fruit pulp with 40% sugar +1.5% citric acid).

Minimum total decrease (8.30) in TSS acid ratio during 120 days of storage was noticed when guava fruit bar was prepared by using guava pulp with 50 percent sugar with 2 percent citric acid. The recipe was next in order in this regard was T_8 (Guava pulp with 60% sugar + 2% citric acid), T_5 (Guava pulp with 50% sugar + 1.5% citric acid). However, significantly maximum change (20.67) was noticed in treatment T1 (Guava fruit pulp with 30% sugar +1.5% citric acid) followed by treatment T2 (Guava fruit pulp with 30% sugar +2% citric acid) and treatment T_3 (Guava fruit pulp with 40% sugar +1.5% citric acid).

Minimum total decrease (0.18%) in reducing sugars during 120 days of storage was noticed when guava fruit bar was prepared by using guava pulp with 50 percent sugar and 2 percent citric acid. The recipe next in order in this regard was T_8 (Guava pulp with 60% sugar + 2% citric acid), T_5 (Guava pulp with 50% sugar + 1.5% citric acid). However, significantly maximum change (0.49%) was noticed in treatment T_1 (Guava fruit pulp with 30% sugar +1.5% citric acid) and it was followed by treatment T_2 (Guava fruit pulp with 30% sugar +2% citric acid) and T_3 (Guava fruit pulp with 40% sugar +1.5% citric acid). From the above result it is observed in general that, there was gradual increase in reducing sugars of guava fruit bar during storage. Due to transposition of non reducing sugars into reducing sugars and the modification of polysaccharides to monosaccharide's the reducing sugars increased. The results mentioned above are in conformity with the findings of different research workers. The increase in reducing sugars has also been observed during storage of mango leather by Rao and Roy (1983). In Apricot-soy toffees, an increase in reducing sugar during storage period was recorded by Thakur *et al*. (2007) [18] Similar result have been record by Sreemathi *et al*. (2008) in sapota-papaya bar. Vidya and Narain (2011) [19] observed that there was increase in reducing sugars of wood apple bar during storage. Phimphaian *et al*. (2011) also found an increase in reducing

sugars during storage. Shakoor *et al.* (2015) [16, 17] reported increased reducing sugars during storage period of guava bar.

Minimum total increase (0.05%) in non reducing sugars during 120 days of storage was noticed when guava fruit bar was prepared guava pulp with 50 percent sugar and 2 percent citric acid. The recipe was next in order in this regard was T_8 (Guava pulp with 60% sugar + 2% citric acid) and T_5 (Guava pulp with 50% sugar + 1.5% citric acid). However, maximum change (0.20%) was noticed in treatment T_2 (Guava fruit pulp with 30% sugar +1.5% citric acid) followed by treatment T_3 (Guava pulp with 40% sugar + 1.5% citric acid) and treatment T_1 (Guava pulp with 30% sugar + 1.5% citric acid).

Minimum total increase (0.23%) in total sugars during 120th day of storage was noticed when guava fruit bar prepared by using guava pulp with 50 percent sugar and 2 percent citric acid. The recipe found next in order in this regard was T_8 (Guava pulp with 60% sugar + 2% citric acid). However, maximum change (0.67%) was noticed in treatment T_1 (Guava pulp with 30% sugar + 1.5%citric acid) followed by treatment T_2 (Guava pulp with 30% sugar + 2% citric acid) and treatment T_3 (Guava fruit pulp with 40% sugar +1.5% citric acid). From the above result it is observed in general that, there was gradual increase in total sugars of guava fruit bar during storage. The increase in total sugars of guava fruit bar during storage was probably due to the increase in TSS and sugars would attributed to the conversion of starch and other insoluble carbohydrates into sugars. The result mentioned above are in conformity with the findings of various research workers. the increase in sugar was also observed in storage life of pomegranate fruits by Pota *et al.* (1987) [11] where the increase would be attributed to the conversion of starch and other insoluble carbohydrates into sugars. Significant changes were observed in total sugars by Arun *et al.* (1998) [1] during storage of cereal based papaya powder. Sandhu *et al.* (2001) [14] noticed that total sugars of guava leather were increased with the increase of storage period. Vidya and Narain (2011) [19] reported that, there was gain in total sugar contents of jam and fruit bar of woodapple during the storage period. Kuchi *et al.* (2014) [7] reported that total sugars were increase the jelly bar stored in ambient condition.

Minimum total decrease (17.67mg/100g) in ascorbic acid at 120 day of storage was noticed when guava fruit bar was prepared by using guava pulp with 50 percent sugar and 2 percent citric acid. The recipe found next in order in this regard was T_8 (Guava pulp with 60% sugar + 2% citric acid). However, maximum change (43mg/100g) was noticed in treatment T_1 (Guava pulp with 30% sugar + 1.5% citric acid) followed by treatment T_2 (Guava pulp with 30% sugar + 2% citric acid) and treatment T_3 (Guava fruit pulp with 40% sugar +1.5% citric acid). From the above result it is observed in general that, there was progressive decrease in ascorbic acid of guava fruit bar during storage. The decrease in ascorbic acid of guava fruit bar during storage was probably due to oxidation of ascorbic acid. The result mentioned above are in conformity with the findings of various research workers. Manimegalai *et al.* (2001) [9] reported a significant remarkable reduction in ascorbic acid content of sample during storage. Jain and Nema (2007) [5] reported that the ascorbic acid content of leather of all cultivars of guava showed decreasing trend with recipes when sugar content was increased during the storage period. According to Kumar *et al.* (2007) [8] considerable reduction in vitamin C content of the guava leather during storage under ambient conditions was observed. Loss of ascorbic acid have been reported in sapota-papaya bar during 3 months storage (Sreemathi *et al.* 2008). Rao and Roy reported loss of ascorbic acid in mango leather during storage of 3 months.

Minimum total decrease (0.08mg/100g) in phosphorus during 120 day of storage was noticed when guava fruit bar was prepared guava pulp with 50 percent sugar with 2 percent citric acid. The recipe found next in order in this regard was T_8 (Guava pulp with 60% sugar + 2% citric acid). However, maximum change (0.21mg/100g) was noticed in treatment T_1 (Guava pulp with 30% sugar + 1.5% citric acid) followed by treatment T_2 (Guava pulp with 30% sugar + 2% citric acid) and treatment T_3 (Guava fruit pulp with 40% sugar +1.5% citric acid).

Minimum total decrease (0.12mg/100g) in calcium during 120th day of storage was noticed when guava fruit bar prepared by using guava pulp with 50 percent sugar and 2 percent citric acid. The recipe found next in order in this regard was T_8 (Guava pulp with 60% sugar + 2% citric acid). However, significantly maximum change (0.23mg/100g) was noticed in T_1 (Guava pulp with 30% sugar + 1.5% citric acid) followed by treatment T_2 (Guava pulp with 30% sugar + 2% citric acid) and treatment T_3 (Guava fruit pulp with 40% sugar +1.5% citric acid). From the above result it is observed in general that, there was progressive decrease in calcium of guava fruit bar during storage Vidya and Narain (2011) [19] reported decreasing trend in calcium content of both woodapple jam and woodapple fruit bar during 90 days of storage.

Treatment	pH	Total Soluble Solids (°Brix)	Titratable acidity (%)	TSS acidity ratio	Reducing sugars (%)	Non reducing sugars (%)	Total sugars (%)	Ascorbic acid (mg/100g)	Phosphorus (mg/100g)	Calcium (mg/100g)
	Storage Period (days)	Storage Period (days)	Storage Period (days)	Storage Period (days)	Storage period (days)	Storage Period (days)	Storage Period (day)	Storage period (Days)	Storage Period (days)	Storage Period (days)
	120th	120th	120th	120th	120th	120th	120th	120th	120th	120th
T_1	3.56	68.60	1.92 (1.35)	39.64	4.48 (2.11)	37.65 (6.200)	41.60 (6.549)	82.60	19.15	17.00
T_2	3.54	68.52	1.89 (1.32)	40.61	4.62 (2.13)	37.59 (6.196)	41.65 (6.552)	80.00	19.18	16.98
T_3	3.55	71.42	1.96 (1.32)	38.72	4.68 (2.14)	37.58 (6.195)	41.73 (6.552)	79.31	19.24	17.01
T_4	3.47	70.40	1.90 (1.22)	41.78	4.72 (2.11)	37.61 (6.188)	41.78 (6.538)	76.65	19.23	16.99
T_5	3.49	73.24	1.95 (1.22)	40.75	4.78 (2.12)	37.60 (6.187)	41.85 (6.539)	77.00	19.25	17.02
T_6	3.40	73.26	1.91	41.22	4.84	37.61	41.90	73.64	19.28	17.01

			(1.17)		(2.12)	(6.185)	(6.539)			
T_7	3.65	74.48	1.93 (1.31)	41.30	4.92 (2.18)	37.56 (6.192)	41.96 (6.566)	73.00	19.31	17.04
T_8	3.58	73.38	1.92 (1.20)	42.24	4.98 (2.16)	37.58 (6.184)	42.02 (6.550)	72.64	19.34	17.00
T_9	3.80	73.41	1.98 (1.29)	40.81	5.04 (2.20)	37.56 (6.187)	42.08 (6.568)	69.65	19.36	17.03
T_{10}	3.78	75.34	1.94 (1.26)	43.21	5.12 (2.21)	37.51 (6.183)	42.16 (6.564)	67.21	19.38	17.02
'F' test	206.3	127139.49	31.38	87237.8	1053.9	34.118	669.8	48358	132.1	5.03
SE(m)±	0.007	0.005	0.003	0.003	0.002	0.005	0.005	0.005	0.005	0.006
CD at 5%	0.015	0.011	0.008	0.007	0.010	0.011	0.012	0.012	0.011	0.013

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