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Study on Physico-Chemical Properties of Value Added Guava (*Psidium guajava* L.) Toffee during Storage

Arvind Saini [a++*], V. M. Prasad [a#] and Saket Mishra [a†]

[a] *Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj, U.P., 211007, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present experiment was carried out during June 2022 to September 2022 in post- harvest laboratory of Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in (CRD) completely randomized design, with ten treatments which were replicated thrice. The treatments were T_0: (Blanching) Control, T_1: (Blanching) Sugar 70% + Chocolate 10% + Mango 0.5%, T_2: (Blanching) Sugar 70% + chocolate 10% + Strawberry 0.5%, T_3: (Blanching) Sugar 70%+ chocolate 10% + Oragne 0.5%, T_4: (Blanching) Sugar 70% + chocolate 10% + Pineapple 0.5%, T_5: (Sulphitation) control, T_6: (Sulphitation) Sugar 70% + chocolate 10% + Mango 0.5%, T_7: (Sulphitation) Sugar 70% + chocolate 10% + strawberry 0.5%, T_8: (Sulphitation) Sugar 70% + chocolate 10% +Orange 0.5%, T_9: (Sulphitation) Sugar 70%+ chocolate 10% + Pineapple 0.5%. The Guava toffee was stored for 45 days at ambient temperature. From the present investigation it is found that treatment T_4 is superior in respect of phyisco-chemical parameters like total soluble solids, acidity, ascorbic acid, pH and total sugar.

[++] *M.Sc. Scholar;*
[#] *Professor;*
[†] *Assistant Professor;*
**Corresponding author: E-mail: saini.arvind11301@gmail.com;*

Treatment T_4 is also found superior in organoleptic scoring of Guava toffee. In terms of benefit cost ratio the net return, was also found T_4 and minimum was recorded in T_0 in all the parameters.

Keywords: Guava; toffee; physico-chemical properties; economics.

1. INTRODUCTION

"Guava (*Psidium guajava* L.) is one of the most important subtropical fruit crops. It belongs to family myrtaceae. Guava is a native tropical America perhaps from maxico and peru. It is widely distributed all over the equatorial regions of the tropical and sub tropical climate. It is commonly called poor man's fruit" [1]. "It is a big source of Vitamins C, A, B (riboflavin) and minerals like calcium, phosphorus and iron. It contains about 180-300 mg of vit. per 100 g of pulp" [2]. "Its juice is used to blend the pear and peach juice. Guava fruits are used as mixed fruit chats in parties". [3]. "It is a big source of Vitamins C, A, B (riboflavin) and minerals like calcium, phosphorus and iron. It contains about 180-300 mg of vit. per 100 g of pulp. Ripe guava fruits contain 14 percent TSS; 0.3 percent acidity and 7 percent fiber. Guava fruits are used for Jam and Jelly and toffee making" [4]. "Guava is considered to be one of the exquisite, nutritionally valuable and remunerative crops, bears heavy crop every year and give good economic returns. This has prompted several farmers to take up guava orcharding on a commercial scale. In recent years, guava is gaining popularity in the international trade due to its nutritional value and processed products. Guava is rich source of vitamin A, 250 I.U. and vitamin B ,0.7 mg. niacin 1.2 mg., Vitamin C, 302 mg. Calcium 30mg. phosphorous 29 mg. carbs 17.1 gm., protein 1.0 gm. Calories. The ripe fruit is usually eaten as desert, it can also utilize in many ways for making jellies, jam, paste, juice, toffee, baby food, syrup and other processed products" [5].

"Fruit toffee are made from pulpy fruit like banana, mango, jackfruit, guava etc. fruit are grown seasonally and are perishable in nature. Fruit preservation technique enable the mankind to enjoy fruit during even off-season fruit toffee are one such product. Fruit toffee are highly nutritious products compared to sugar boiled confectionaries. The prerequisite for this project is availability of fruit all round the year. The state of uttranchal produces many fruit and thus availability round the year would not be a problem. The technology is easy and standardized and the capital cost of the project is also not very high" [6].

"Among the different products of guava toffee is preferred by all groups of people but standardized recipe of a good quality toffee has not yet been reported. Undoubtedly this product holding all the characteristics of guava will not have a good market value with longer shelf life then its other products" [7].

2. MATERIALS AND METHODS

The present investigation entitled "Study on physico-chemical properties of value added guava toffee during storage" was laid out in the Post Harvest Lab Department of Horticulture, Prayagraj for a period of 6 months (Sept 2022-Feb 2023). In respect of phyisco-chemical parameters like total soluble solids,acidity, ascorbic acid, pH and total sugar. The treatments were T_0: (Blanching) Control, $T_{1:}$ (Blanching) Sugar 70%+Chocolate 10% + Mango 0.5%, $T_{2:}$ (Blanching) Sugar 70%+chocolate 10% + Strawberry 0.5%, T_3: (Blanching) Sugar 70%+ chocolate 10% +Oragne 0.5%, T_4: (Blanching) Sugar 70%+ chocolate 10% + Pineapple 0.5%, T_5: (Sulphitation) control, T_6: (Sulphitation) Sugar 70% + chocolate 10% +Mango 0.5%, T_7: (Sulphitation) Sugar 70%+ chocolate 10% +strawberry 0.5%, T_8: (Sulphitation) Sugar 70%+ chocolate 10% + Orange 0.5%, T_9: (Sulphitation) Sugar 70% + chocolate 10% + Pineapple 0.5%.

3. RESULTS AND DISCUSSION

Total Soluble Solids (TSS) of guava toffee was observed to increase continuously up to the end of research under ambient storage conditions. The total soluble solid of Guava toffee differed significantly in all the treatments as well as during storage period at 0, 15, 30, and 45 Days. The highest total soluble solid (^{0}Brix) observed was (78.9) with the treatment T_9 followed by T_4 While the lowest total soluble solid (^{0}Brix) observed was (71.6) with the treatment.This findings correlates the findings of Ahmad and Tariq [8], Manivasaganet et al. [9] and Mall and Tandon [10].

pH of was guava toffee observed to decrease continuously up to the end of research under

ambient storage conditions lowest pH observed was (3.75) with the treatment T_2, followed by treatment T_1 ,the lowest pH highest was (5.58) with the treatment T_4. This findings correlates the findings of Braimwelland Badrie [11], Siddiqui [12] and Khushbu et al. [13].

Acidity of guava toffee was observed to decrease continuously up to the end of research under ambient storage conditions lowest acidity (%) observed was (0.18) with the treatment, T_0 ,T_3 , While the maximum acidity (%) observed was (.288) T6 This findings correlates the findings of Rathoreet al. [14] and Khushbu et al. [13].

Ascorbic acid (mg/100g) of guava toffee was observed to decrease continuously up to the end of research under ambient storage conditions. maximum ascorbic acid (mg/100 g) observed was (19.02) with the treatment T_4,followed by T_3, T_2. While the lowest ascorbic acid (mg/100 g) observed was (13.87) with the treatment T_0. Similar results were reported by Daisy and Gehlot [15] in Aonla preserve, singh) et al. [16]

Reducing sugar (%) of guava toffee was observed to increase continuously up to the end of research under ambient storage conditions. maximum reducing sugar observed was (10.30) with the treatment T_0 (Blanching) Control, followed by treatment, T_1, T5 , While the maximum Reducing sugar (%) observed was (14.50) with the treatment T_4 .Similar results were reported by Daisy and Gehlot [15] in Aonla preserve.

Non-reducing sugar (%) of guava toffee was observed to increase continuously up to the end of research under ambient storage conditions. lowest non-reducing sugar observed was (6.1) with the treatment T0 Control followed by treatment, T_5, T_1 While the minimum Non-Reducing sugar (%) observed was (3.89) with the treatment T_4. Non-reducing sugar in any food commodity plays important role in deciding its shelf life. Usually, high sugar content makes the moisture unavailable for the growth of microorganisms, thus improves the shelf life of food. Similar results were reported by Daisy and Gehlot [15] in Aonla preserve.

Total sugar (%) of guava toffee was observed to increase continuously up to the end of research under ambient storage conditions. maximum total sugar maximum total sugar (%) observed was (18.39) with the treatment T_4 followed by treatment, T8 ,T_2 While the lowest total sugar (%) observed was (16.40) with the treatment T_0. Similar results were reported by Krishnaveni et al. (2001) in jack fruit RTS, Jain et al. [17] in papaya cubes.

Colour and Appearance (sensory score) of guava toffee was observed to decrease continuously up to the end of research under ambient storage conditions. highest score of colour was noted (8.62) with the T_3 treatment followed by treatment T_9, While least score of colour was noted (6.7) with the treatment T_0. Colour and in any food commodity plays important role in deciding its market value. colour is an attribute of food quality and loss of colour by osmotic dehydration process is one of the most significant changes. Similar results were reported by mondal et al., in aonla candy [18].

Flavour (sensory score) of guava toffee was observed to decrease continuously up to the end of research under ambient storage conditions highest score of Flavour was noted (8.63) with the treatment T_4 followed by treatment, T_3, T_2 While least score of Flavour was noted (6.4) with the treatment T_0 This findings correlates the findings of Rathore et al. [14], Shakti et al. [19] and Khushbu et al. [13].

Taste (sensory score) of guava toffee was observed to decrease continuously up to the end of research under ambient storage conditions. flavour was noted (8.54) with the treatment T_3 followed by treatment, T_2 While least score of Taste was noted (6.45) with the treatment T_0 . This might be due to degradation of volatile substance and flavor constituents. Similar results were reported by Ames [20] and Chavan [21] in Jackfruit products.

Consistency (sensory score) of guava toffee was decrease continuously up to end of research under ambient storage condition the , highest score of Consistency was noted (7.39) with the treatment T_2 followed by treatment T_1,While least score of Consistency was noted (6.8) with the treatment T_0 Control. The finding correlates the findings of Nidhi, Prasad, V. M. et al. [22].

Overall acceptability (sensory score) of guava toffee was observed to increase continuously up to the end of research under ambient storage conditions. highest score of overall acceptability was noted (8.54) with the treatment T_3 followed by treatment T_4 While least score of overall acceptability was noted (6.4) with the treatment T_0 Control,This findings correlates the findings of Vikram and Singh [23] and Rekha et al. [24].

Table 1. Effect of flavour on TSS (^{0}Brix), p^H and Acidity % of guava toffee during storage

S.No.	Treatment	Total soluble solid (^{0}Brix)				pH				Acidity (%)			
		0 Day	15 Days	30 Days	45 Days	0 Day	15 Days	30 Days	45 Days	0 Day	15 Days	30 Days	45 Days
1	T_0	74.150	72.963	73.700	74.041	5.047	5.092	5.135	5.793	0.226	0.225	0.233	0.195
2	T_1	72.883	73.630	74.580	74.840	4.550	4.660	5.223	5.371	.189	0.256	0.247	0.243
3	T_2	73.103	74.310	74.643	74.970	3.757	4.893	5.193	5.583	0.268	0.259	0.255	0.244
4	T_3	71.603	75.413	75.633	75.473	5.020	5.077	5.077	5.290	0.250	0.247	0.256	0.239
5	T_4	76.927	71.713	72.517	72.843	5.589	5.329	5.239	5.679	0.263	0.257	0.251	0.267
6	T_5	73.573	72.400	72.103	71.820	5.550	5.400	5.127	5.027	0.285	0.269	0.278	0.257
7	T_6	74.980	77.073	77.327	77.640	4.850	5.083	4.933	5.365	0.288	.271	0.278	0.270
8	T_7	73.893	75.013	75.580	75.907	4.792	4.860	4.997	5.202	0.275	0.282	0.275	0.252
9	T_8	76.277	75.000	75.680	75.567	5.280	5.070	5.367	5.771	0.274	0.271	0.261	0.226
10	T_9	78.990	76.447	76.983	76.760	4.893	5.020	5.160	5.370	.250	0.264	0.249	0.210
	F-Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
	S.EM	**0.257**	**0.307**	**0.219**	**0.200**	**.220**	**0.241**	**0.249**	**0.251**	**0.348**	**0.256**	**0.008**	**0.025**
	C.D. at 0.5%	**0.763**	**0.913**	**0.652**	**0.593**	**0.654**	**0.865**	**5.490**	**0.634**	**.032**	**.0176**	**0.025**	**.0187**

Table 2. Effect of flavour on ascorbic acid (mg/100 g) reducing sugar % and non-reducing sugar % of guava toffee during storage

S.No.	Treatment	Ascorbic acid (mg/100 g)				Reducing sugar (%)				Non- reducing sugar (%)			
		0 Day	15 Days	30 Days	45 Days	0 Day	15 Days	30 Days	45 Days	0 Day	15 Days	30 Days	45 Days
1	T_0	13.873	13.807	13.753	13.443	10.307	11.543	12.593	13.580	6.100	6.125	6.867	7.062
2	T_1	17.539	17.363	17.297	17.307	11.203	12.690	13.690	15.570	5.400	5.627	5.840	5.910
3	T_2	18.113	17.553	17.260	17.413	12.517	13.613	14.683	16.383	4.817	4.887	5.600	5.097
4	T_3	18.443	18.203	18.277	18.247	13.437	14.580	15.677	16.653	4.047	4.790	4.723	5.783
5	T_4	19.022	18.567	18.233	18.323	14.507	15.653	16.727	18.447	3.892	4.782	4.639	4.919
6	T_5	14.757	14.973	14.650	14.500	11.527	12.663	14.233	15.397	5.522	5.829	5.362	5.876
7	T_6	15.267	15.757	14.943	14.580	11.630	12.710	13.820	15.257	5.441	5.771	5.746	5.994
8	T_7	16.980	16.043	15.357	15.913	11.947	13.350	14.490	15.620	5.167	5.220	5.213	5.893
9	T_8	17.287	16.820	15.673	16.910	12.140	13.397	14.547	15.623	5.256	5.286	5.112	5.849
10	T_9	14.747	14.323	14.057	13.960	11.617	12.587	13.407	14.703	4.943	5.700	6.053	5.740
	F-Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
	S.EM	**0.329**	**0.394**	**0.380**	**0.216**	**0.178**	**0.087**	**0.139**	**0.118**	**0.26**	**0.135**	**0.197**	**0.153**
	C.D. at 0.5%	**0.976**	**1.170**	**1.128**	**0.643**	**0.529**	**0.260**	**0.414**	**0.351**	**0.800**	**0.402**	**0.584**	**0.455**

Table 3. Effect of flavour on total sugar, colour and flavour of guava tofee during storage

S.No.	Treatment	Total sugar %				Colour				Flavour			
		0 Day	15 Days	30 Days	45 Days	0 Day	15 Days	30 Days	45 Days	0 Day	15 Days	30 Days	45 Days
1	T_0	16.407	17.668	19.460	20.642	6.700	6.363	6.437	6.063	6.413	6.487	6.353	5.977
2	T_1	16.603	18.317	19.530	21.480	8.603	8.317	8.477	7.670	8.427	8.587	8.410	8.170
3	T_2	17.333	18.500	20.283	21.480	8.617	8.457	8.527	8.167	8.537	8.607	8.467	8.220
4	T_3	17.483	19.370	20.400	22.437	8.627	8.450	8.530	8.440	8.550	8.630	8.493	8.230
5	T_4	18.399	20.436	21.366	23.366	8.523	8.543	8.270	8.387	8.633	8.360	8.440	8.237
6	T_5	17.049	18.492	19.596	21.272	7.793	7.403	7.477	7.387	7.513	7.587	7.557	7.563
7	T_6	17.071	18.481	19.566	21.251	8.333	7.900	7.657	7.707	7.997	7.753	7.757	7.707
8	T_7	17.113	18.570	19.703	21.513	8.297	8.170	7.597	7.604	8.270	7.697	8.143	7.643
9	T_8	17.396	18.682	19.659	21.472	8.333	8.377	7.577	7.633	8.457	7.657	8.374	7.757
10	T_9	16.560	18.287	19.460	20.443	7.787	7.543	7.557	7.350	7.623	7.637	7.517	7.517
	F-Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
	S.EM	**0.193**	**0.107**	**0.116**	**0.150**	**0.079**	**0.084**	**0.172**	**0.171**	**0.130**	**0.189**	**0.119**	**0.115**
	C.D. at 0.5%	**0.574**	**0.319**	**0.344**	**0.446**	**0.235**	**0.249**	**0.512**	**0.509**	**0.386**	**0.562**	**0.353**	**0.342**

Table 4. Effect of flavour on score of taste, consistency and overall acceptability and benefit cost ratio of guava toffee during storage

S.No.	Treatment	Taste				Consistency				overall acceptability				B:C Ratio
		0 Day	15 Days	30 Days	45 Days	0 Day	15 Days	30 Days	45 Days	0 Day	15 Days	30 Days	45 Days	
1	T_0	6.457	5.833	5.730	5.257	6.883	6.510	6.013	5.363	6.413	6.277	5.813	5.420	1.08
2	T_1	8.383	7.730	7.663	7.457	7.557	7.393	7.067	6.480	8.430	8.197	7.797	7.373	1.46
3	T_2	8.510	8.487	7.753	7.563	7.396	7.370	6.623	6.550	8.270	8.117	8.480	7.533	1.40
4	T_3	8.543	8.343	7.657	7.550	6.877	7.250	6.973	6.547	8.540	8.313	8.323	7.817	1.45
5	T_4	8.307	8.210	8.257	7.537	6.904	6.853	6.687	6.583	8.507	8.193	8.173	8.087	1.63
6	T_5	7.390	7.367	6.953	6.577	6.851	6.787	6.610	6.540	7.703	7.533	7.437	7.420	1.53
7	T_6	7.543	7.380	7.247	6.973	7.323	7.147	6.890	6.480	7.690	7.570	7.460	7.393	1.51
8	T_7	7.483	7.290	7.313	6.763	7.020	6.613	6.803	6.613	7.983	7.876	7.363	7.220	1.51
9	T_8	7.280	6.867	6.860	6.953	6.941	6.937	6.943	6.660	8.047	7.557	7.070	7.203	1.56
10	T_9	7.490	6.890	6.777	6.403	6.750	6.773	6.787	6.387	7.597	7.283	6.937	6.823	1.59
	F-Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	
	S.EM	**0.174**	**0.128**	**0.103**	**0.197**	**0.121**	**0.174**	**0.121**	**0.150**	**0.112**	**0.147**	**0.148**	**0.146**	
	C.D. at 0.5%	**0.518**	**0.380**	**0.305**	**0.586**	**0.359**	**0.517**	**0.359**	**0.447**	**0.332**	**0.436**	**0.440**	**0.435**	

4. CONCLUSION

Based on present investigation, it is concluded treatment T_4 [(Blanching) Sugar 70%+ chocolate 10% +Pineapple 0.5%] was best in terms of best recipe with value addition for preparation of papaya candy. The same treatment T_4 [(Blanching) Sugar 70%+ chocolate 10% + Pineapple 0.5%] was found best in terms of quality changes in papaya candy during storage. The maximum B:C ratio was observed in T_4 [(Blanching) Sugar 70%+ chocolate 10% + Pineapple 0.5%].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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