Studies on preparation of mixed toffee from guava and strawberry

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Abstract The present investigation was carried out to develop a technology for preparation of mixed toffee from guava and strawberry pulp and to study the changes in chemical composition and sensory properties of toffee during storage at ambient temperature as well as refrigerated condition. Preliminary experiments were conducted to find out optimum levels of guava and strawberry pulp. The toffees prepared were wrapped in metallic coated polythene wrapper, packed in 200 gauge polythene bags and stored at ambient (27 ± 2 °C) as well as refrigerated (5 ± 2 °C) condition for 90 days. The stored samples were drawn periodically at 30 days interval for organoleptic and chemical analysis. Preliminary studies were carried out to standardize the optimum levels of guava and strawberry pulp. Among various combinations of guava and strawberry pulp, 70 : 30 w/w (guava : strawberry) ratios toffee was found better than other combinations in respect to organoleptic properties and nutritional quality. The yield of fresh toffee was higher (868 g/kg of pulp) in toffee prepared from 100 % guava (control). The chemical composition indicated that the fresh toffees contained on an average moisture 8.73 %, TSS 83.21 °Brix, titrable acidity 0.3 %, total sugars 73.1 % and ascorbic acid 64.1 mg/100 g. The mean score of fresh toffees for colour and appearance was 8.29, texture 8.02, flavour 8.22, taste 8.32 and overall acceptability 8.16 on 9 point Hedonic scale. The cost of fresh toffee was Rs. 282/kg which was prepared from 70 : 30 guava and strawberry pulp level.

The storage studies indicated that the TSS and total sugars increased with the advancement of storage period, while moisture content, ascorbic acid and acidity decreased. The rates of increase or decrease were relatively higher at ambient temperature than refrigerated temperature. The sensory quality of toffees also decreased at faster rate during 90 days storage period at ambient condition than the refrigerated condition. The toffee prepared from 70: 30 guava and strawberry pulp was found superior over other combinations in respect of organoleptic properties throughout storage period. However, toffees were found to be acceptable even after 90 days storage at ambient as well as refrigerated conditions.

Keywords Guava · Strawberry · Toffee · Mixed Toffee · Nutritional composition

Introduction

Guava (*Psidium guajava* L.) is a member of dicotyledonous, family Myrtaceae, having Tropical America origin. It is important tropical fruit crop. It is a small tree or shrub of 2 to 8 m in height with wide spreading branches (Singh 1988). India leads the world in guava production (Singhal 1996). Crop in India occupies an area of 2.20 lakh ha with annual production 25.72 lakh MT having productivity 11.70 MT/ha (2010). Maharashtra rank 2nd in production in India (Bijay Kumar 2011). Major guava producing states are Uttar Pradesh, Maharashtra, Bihar, Andra Pradesh, Gujarat, Madhya Pradesh, Karnataka. Guava is an important commercial horticultural crop in Maharashtra with an area of 33,469 ha, with production of 2.58 lakh MT and productivity 7.80 MT/ha (Bijay Kumar 2011).

The quality and nutritional value of guava fruits are influenced by physical and biochemical changes during maturation by photosynthesis and accumulation. Fully mature guava fruits have very strong flavour therefore it is unsuitable to

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use as a table purpose. Fruit is rich source of vitamin C (100–260 mg/100 g) and also good in mineral like phosphorus, calcium, etc. The fresh fruit contents 83 % moisture, 1 % protein with an energy value of 67.78 cal/100 g fruit (Singh et al 1976). In some countries, the fruit is used for curing diarrhea. Guava is normally consumed fresh as a desert fruit. However, guava is highly perishable and cannot be stored for longer period. Moreover considerable proportion of the produce is lost during post-harvest linkage (Ahire 1989). It is, therefore, imperative to develop suitable technology for preservation and processing of such surplus produce.

Botanical classification of the strawberry is Kingdom Plantae, Order Rosales, Family Rosaceae, Subfamily Rosoideae, Tribe Potentilleae, Subtribe Fragariinae, Genus *Fragaria*. It is octaploid ($2n=8\times=56$) with basic chromosome number 7. *Fragaria ananassa* is cross between *F. chiloensis* and *F. virginiana* and is a man made fruit crop. It is also called as 'False fruit'. North America is native of strawberry. In India it is cultivated in Himachal Pradesh, Uttar Pradesh, Punjab, Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, West Bengal and Delhi. Sub tropical areas in Jammu have also the potential to crop under irrigated condition.

It is monoecious, short day, non-climacteric, aggregate, temperate type's fruit. The edible portion of strawberry is succulent thalamus of the flower which include receptacle with numerous achenes (Salaria and Salaria 2009).

According to Chavan 2015, whole fruit of strawberry contains 89.9 % moisture, 0.7 % protein, 0.5 % fat, 5 % total sugars, 1.3 % crude fibre, energy value of 37 Kcal per 100 g of fruits. It has 0.52 to 2.26 % acidity (as citric acid) and contains 0.5 % total minerals among which are (mg/100 g) phosphorus (23), potassium (161), calcium (22), sodium (1.5) and magnesium (11.7). It contains 89 mg of ascorbic acid per 100 g of fruits. It is generally considered to be a poor source of other vitamins as it contains (mg/100 g) carotene (0.15), thiamine (0.03), riboflavin (0.027) and nicotinic acid (0.6).

Strawberry highly rated as skin cleaning food, it is known to clean or rid the blood harmful toxins, it sluggish liver, gout, high blood pressure, dissolve tartar on teeth, strengthens and heals the gums, also preventing mouth and lip cancer.

Strawberry is tonic, diuretic, mineralizing, astringent and laxative. Strawberry essence used in beauty treatment. Influenced strawberry leaves counteract diarrhea, while an infusion made from the roots is said to have a diuretic effect.

Popular varieties of strawberries are Chandler, Douglas, Fern, Selva the classification of the variety according to erect plant type, day neutral, firm flesh type, summer type, large fruited type and high runner producer (Kishore et al. 2006).

Fruiting time in Maharashtra and most of other states of India for strawberry is November–March. Fruits available in Mid November to March which are planted in August to September on area 20,000 to 25,000 plants per acre can be planted. Thus, it is possible to obtain 20–25 tons strawberry

yield getting 40–50 fruit/plant with an average weight of fruit is 20–25 g. Therefore one plant can produce 1 to 1.25 kg strawberry fruit (Kharche 1994).

Guava pulp having very strong flavour with high vitamin C content. Therefore, it will be very worthwhile to mix guava pulp with other fruit pulp having less flavour to form combination of both to yield good quality processed fruit product. Toffee is one of the confectionery products. It is reported that pulpy fruits like mango, guava, papaya, fig, jackfruit etc. can be utilized for preparation of toffee, such fruit toffees naturally are very nutritious as they contain most of the constituents of the fruit from which they are prepared (Jain et al. 1958). However, very little work is done on mixed fruit toffees. It is possible to prepare the toffee combining guava pulp and strawberry pulp and make their combination to get desired properties from mixed fruit toffee. It is, therefore, proposed to utilize guava and strawberry fruits with various combinations for toffee making.

Materials and methods

Fruits Fully matured guava (Sardar) fruits were obtained from the All India Co-ordinated Research Project on Dry Land Fruit Crops of the Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri and The strawberry fruits were obtained from Mahabaleshwar local market respectively for research work.

Chemicals and additives Most of the chemicals used in this investigation were of analytical grade. Cane sugar, hydrogenated fat, salt and skim milk powder were obtained from local market and used as additives for preparation of guava and strawberry mixed toffee.

Packaging materials Butter paper and metallic coated polythene wrappers and polythene 200 gauge bags were obtained from local market.

Extraction of pulp Fully mature guava and strawberry fruits with firm texture, uniform in size were used for the experiment. The fruits were washed under tap water, dried cut into pieces and were passed through the sieve and home scale pulping machine to obtain a fine pulp respectively.

Standardization of toffee recipe Guava and strawberry mixed toffees were first prepared by using 11 combinations of different levels of pulps with other ingredients such as sugar, hydrogenated fat, skim milk powder and salt were kept constant (Table 1). The level of pulps was finalized by sensory evaluation of toffees by a panel of minimum 10 semi-trained judges using 9 point hedonic scale (Amerine et al. 1965).

Table 1 Various combinations of guava and strawberry pulp for preparation of mixed toffees

Sr. No.	Guava pulp %	Strawberry pulp %	Organoleptic overall acceptability score	Ranks/Remarks	Ranking for further study
1.	100	0	8.13	Control	T1
2.	0	100	7.86	Control	T2
3.	90	10	7.98	Not selected	—
4.	85	15	8.0	Not selected	—
5.	80	20	8.05	Not selected	—
6.	75	25	8.16	Selected further study	T3
7.	70	30	8.45	Selected further study	T4
8.	65	35	8.20	Selected further study	T5
9.	60	40	8.01	Not selected	—
10.	55	45	7.88	Not selected	—
11.	50	50	7.60	Not selected	—

Other ingredients such as sugar: 500 g, fat: 100 g, skin milk powder: 50 g, salt: 2 g, cocoa powder 4 g were kept constant for preparation of toffee. Mean of ten observations

* Nine point hedonic scale; ten semi-trained judges were used for sensory evaluation

Preparation of toffee Five types of toffees were finally prepared using optimum levels of guava pulp : strawberry pulp 100 : 00 (guava control) and 00:100 (strawberry control), 75 : 25, 70 : 30 and 65 : 35 w/w and other ingredients such as sugar 500 g, butter fat 100 g, skim milk powder 50 g and salt 2 g per kg pulp were kept constant. The homogenized pulps were taken into stainless steel container and mixed well with other ingredients such as sugar, butter fat, skim milk powder as per the treatment. The mixture was heated till the TSS content reached 80 °Brix. Salt was dissolved in small quantity of water and mixed with the above mixture and again heated till TSS of content reached 82–83 °Brix. The heated mass was spread into a thin sheet of 1 to 2 cm thickness in stainless steel plate that was already smeared with fat. This was allowed to cool and set for two to 3 h, and then the solid sheet was cut into cubes of 1.5 to 2.5 cm with a stainless steel knife.

Chemical analysis of toffees The toffee was chemically analysed for moisture, TSS, acidity, reducing sugar and total sugar contents according to the standard methods of (AOAC 1990).

Sensory evaluation of toffees The sensory evaluation of guava and strawberry mixed toffees were carried out according to the standard procedure (Amerine et al. 1965) on a 9 point hedonic scale. The mean score of minimum 10 semi trained judges

(professors and research scientists) for each quality parameter viz., colour and appearance, texture, taste, flavour and overall acceptability was recorded.

Packaging and storage of toffees The toffees prepared were wrapped in metallic coated polyethylene wrappers with four replications. The wrapped toffees were packed in plastic bags (200 gauge) and stored at ambient temperature (27 ± 2 °C) as well as at refrigerated condition (10 ± 2 °C) upto 90 days. The stored toffees were evaluated for chemical composition, sensory properties and microbial quality at an interval of 30 days.

Microbial quality of toffees Microbial count was recorded using standard plate count (SPC). One colony was counted as microbes. The trypton dextrose yeast extract agar was used as growth medium and petridishes were incubated at 37 ± 5 °C for 48 h for counting bacterial colonies. The colonies were counted with magnifying lens. Total count was taken along with pin point colonies.

Statistical analysis The data obtained in the present investigation was analyzed using Factorial Completely Randomized Design (FCRD) with three replications for chemical analysis and ten replications for organoleptic evaluation for statistical significance according to Panse and Sukhatme 1967.

Results and discussion

Recovery of pulp from fruits The recovery of guava pulp was recorded as 938 g/kg of fruit without straining while recovery of strawberry pulp was recorded as 985 g/kg of fruit. Kohinkar et al. 2012 reported 99 % fig pulp and 65 % guava pulp. Pawar et al. 1992 reported that the fig fruits consist of 84 % skin and 16 % seeds. (Khandekar et al. 2005) was reported the recovery of Fig. 995.50 g/kg of fruit.

Standardization of ingredient levels for preparation of toffees The toffee prepared by using 70:30 guava pulp: strawberry pulp and 500 g sugar, 100 g butter fat, 50 g skim milk powder, 4 g cocoa powder and 2 g salt/kg of pulp was found superior in colour and appearance, texture, taste, flavour and overall acceptability to those prepared by using other combinations (Table 1).

Yield of toffee The yield of guava and strawberry mixed toffees ranged from 713 to 868 g/kg of pulp (Table 2). It was reported that the yield of fig toffees ranged from 1.218 to 1.220 kg/kg of pulp (Khandekar et al. 2005). Also the yield of guava toffees was reported as 1.410 to 1.360 kg/kg of pulp (Jain et al. 1958). It was reported that, the yield of custard apple toffee increased to 1.35 kg/kg of pulp with increase in

Table 2 Yield and chemical composition of fresh guava and strawberry mixed toffees

Treatment	Yield (kg/kg of pulp)	Moisture (%)	TSS (°Brix)	Acidity (%)	Reducing sugars (%)	Total sugars (%)	Ascorbic acid (mg/100 g)
T ₁	0.868	8.31	82.40	0.26	35.71	74.07	88.53
T ₂	0.713	8.83	82.65	0.38	33.81	72.13	39.52
T ₃	0.813	8.81	84.00	0.27	33.75	73.43	70.13
T ₄	0.795	8.83	84.35	0.29	34.23	73.13	62.80
T ₅	0.787	8.84	82.64	0.30	34.12	72.82	59.32
Mean	0.795	8.73	83.21	0.30	34.32	73.12	64.06
S.E. ±	—	0.033	0.006	0.002	0.716	0.040	0.007
CD at 5 % (n=3)	—	0.104	0.018	0.004	2.148	NS	0.022

* Nine point hedonic scale; ten semi-trained judges were used for sensory evaluation

sugar level (Dhumal et al. 1996). The 165 yield of tamarind, 166 mango, and papaya blended toffees was reported 1.196 to 1.210 kg/kg of pulp (Nale et al. 2007; Kaushal et al. 2001; Kerawala and Siddappa 1963a, b).

Chemical composition of fresh toffees The moisture content of guava and strawberry mixed toffees were ranged from 8.3 to 8.8 %. There was a significant difference in moisture contents of toffee. It was reported that the moisture content of guava toffees ranged from 8.3 to 8.5 % (Jain et al. 1958). The moisture content of fig toffees was recorded within the range of 8.4 to 8.5% (Khandekar et al. 2005).

Total soluble solids (TSS) The TSS content of fresh guava and strawberry mixed toffees ranged from 82.40 to 84.35 oBrix. The treatment 70:30 (guava : strawberry) combination had higher TSS content as compared to the other all treatments. There was a significant difference between the TSS of treatments. The TSS of fig toffee was ranged from 82.5 to 83.7 oBrix (Khandekar et al. 2005). The TSS of guava fruit toffee was ranged from 82.1 to 82.4 oBrix. The TSS of custard apple toffee ranged from 82.4 to 82.8 oBrix (Dhumal et al. 1996). The TSS of tamarind, mango and papaya blended toffee was reported 84.2 to 84.8 oBrix (Nale et al. 2007; Siddappa and Kerawala 1963a, b, c).

Acidity The titrable acidity of guava and strawberry mixed toffee ranged from 0.26 to 0.38 %. The treatment 100:00 (guava : strawberry) combination had acidity 0.26 %, while 00:100 (guava : strawberry), 75 : 25, 70 : 30 and 65 : 35 combination of guava and strawberry had 0.38, 0.27 0.29 and 0.30 % respectively.

Reducing sugars The reducing sugar content of guava and strawberry mixed toffee ranged from 33.7 to 35.7 %. The treatment 75:25 combination contains minimum reducing sugars (33.7 %) than other combinations. This difference in reducing sugars content of fresh toffee was might be due to different level of pulps used. There was significant difference

in the reducing sugars contents of fresh mixed toffee. The reducing sugars content of fresh fig toffee was reported 36.3 to 39.1 % (Khandekar et al. 2005). The guava fruit toffee had reducing sugars content in between the range of 40.9 to 41.3 %.

Total sugar The total sugars content of guava and strawberry mixed toffees ranged from 72.1 to 74.1 % (Table 2) initially. The total sugars content of fig toffee was reported from 73.6 to 75.8 % (Khandekar et al. 2005). Similarly guava toffee contained 75.1 to 77.2 % total sugars. It was reported that total sugars content of mango toffees was 67.3 % (Kerawala and Siddappa 1963a, b), custard apple toffee 72.2 to 78.9 % (Dhumal et al. 1996) and tamarind, mango and papaya blended toffees 55.7 to 60.1 % (Aruna et al. 2000; Nale et al. 2007).

Ascorbic acid The ascorbic acid content of guava and strawberry mixed toffee ranged from 39.5 to 88.5 %. As the percentage of strawberry pulp increases the ascorbic acid decreases (Chauhan et al. 1998).

Sensory properties of fresh guava and strawberry mixed toffees

Colour and appearance The score for colour and appearance was 8.1, 8.3, 8.2, 8.4 and 8.4 for treatments 100:00, 00:100, 75:25, 70:30 and 65:35 respectively (Table 3). As level of strawberry pulp in toffee increases the score for colour and appearance get increased.

Texture The score for texture of guava and strawberry plus mixed toffees were in the average range 7.9 to 8.1. The toffees with 70:30 blends (guava and strawberry) scored maximum (8.1), while toffees with 100:00 and 00:100 (guava and strawberry) scored minimum (7.9).

Flavour Flavour score for guava and strawberry mixed toffee ranged from 8.0 to 8.5. There was significant difference in the

Table 3 Sensory score of fresh toffees prepared from guava and strawberry mixed fruit pulps

Treatment	Sensory score*				
	Colour and appearance	Texture	Flavour	Taste	Overall acceptability
T ₁	8.10	7.98	8.11	8.14	8.13
T ₂	8.32	7.93	7.99	7.93	7.86
T ₃	8.20	8.03	8.21	8.33	8.16
T ₄	8.45	8.12	8.47	8.64	8.45
T ₅	8.39	8.05	8.32	8.56	8.20
Mean	8.29	8.02	8.22	8.32	8.16
S.E. ±	0.063	0.084	0.057	0.103	0.211
CD at 5 % (n=10)	0.187	NS	0.168	0.305	NS

* Nine point hedonic scale; ten semi-trained judges were used for sensory evaluation

scores for flavour. The treatment 70:30 (guava:strawberry) blended toffee scored maximum (8.5), while treatment 00:100 blend (guava : strawberry) scored minimum (8.0). The increase in score of flavour is might be due to increase in guava pulp level in toffees.

Taste The taste scores for fresh guava and strawberry mixed toffees were ranged from 7.9 to 8.6. The higher level of strawberry pulp might be responsible for giving good taste score to the toffee. The sensory score for taste of papaya toffee was 8.1 to 8.4 (Diwate *et al.* 2004). The score for taste of tamarind, mango, and papaya blended toffees was ranged from 8.0 to 8.8 (Nale *et al.* 2007).

Overall acceptability There were significant differences among the treatment for overall acceptability. The mixed toffee of treatment 70 : 30 blend score maximum (8.4), treatment

65 : 35 medium (8.2) and treatment 00 : 100 blend minimum (7.8) for overall sensory scores were recorded. This is might be due to better colour and appearance, texture, flavour, taste and combination of mixed toffees prepared from guava and strawberry pulps.

Changes in chemical composition of guava and strawberry mixed toffee during storage There was significant decrease in moisture content of toffee during storage for different treatments. The minimum moisture loss of toffee was recorded in treatment 65 : 35 % blend of guava and strawberry toffee from 8.8 to 8.3 % and from 8.8 to 8.3 % at ambient and refrigerated condition respectively. This might be due to the temperature difference in the storage conditions.

Total soluble solids (TSS) The mean of TSS of five toffees prepared from guava and strawberry pulps mixed toffees increased from 83.2 to 84.9 oBrix at ambient and from 83.2 to 84.5 oBrix at refrigerated storage conditions, respectively (Table 4). There was significant increase in the T.S.S. of toffees in different treatments. The increase in TSS during storage period of mixed toffee might be due to decrease in moisture content during storage.

Acidity At ambient condition maximum decrease was observed in treatment T₂ from 0.38 to 0.23 % followed by treatment T₅ from 0.30 to 0.22 % and treatment T₄ from 0.29 to 0.23 %. At refrigerated condition the acidity per cent was decrease merely in treatment T₄ from 0.29 to 0.23 % followed by treatment T₅ from 0.30 to 0.24 %. The rate of decrease in acidity % was faster in ambient storage than the refrigerated storage.

Reducing sugars At ambient temperature, maximum increase in reducing sugars content was observed for treatment T₃ from 33.7 to 34.5 %. At refrigerated condition also maximum

Table 4 Effect of storage period and pulp combinations on chemical composition of mixed toffee of guava : strawberry after 3 months storage

Treatment (Guava : Strawberry)	Moisture (%)		TSS (%)		Acidity (%)		Reducing sugars (%)		Total sugars (%)		Ascorbic acid (mg/100g)		Standard plate count (log cfu/g)	
	A	R	A	R	A	R	A	R	A	R	A	R	A	R
T ₁ =100:00	7.81	7.93	84.00	83.20	0.21	0.22	36.58	36.35	74.82	74.65	87.17	87.24	7.5	6.5
T ₂ =00:100	8.29	8.39	85.10	84.85	0.23	0.25	34.65	34.69	72.82	72.59	38.14	38.24	8.5	7.5
T ₃ =75:25	8.03	8.13	85.30	85.14	0.21	0.22	34.52	34.35	75.00	74.70	68.72	68.73	5.5	4.5
T ₄ =70:30	8.17	8.24	85.50	85.30	0.22	0.23	34.45	34.32	74.99	74.84	61.41	61.37	5.5	4.5
T ₅ =65:35	8.25	8.33	84.59	84.03	0.23	0.24	34.55	34.38	74.86	74.62	57.87	57.93	5.5	4.5
Mean	8.11	8.20	84.90	84.51	0.22	0.23	34.95	34.82	74.50	74.28	62.66	62.70	6.5	5.50
C. D. 5 % (n=3)	0.163	0.254	0.066	0.111	0.024	0.025	2.451	2.332	0.343	0.355	0.015	0.100	NS	NS

A Ambient (27±2 oC), R Refrigerated (5±2 oC)

increase in reducing sugar content was observed in treatment T₃ from 33.7 to 34.3 %. The rate of increase of reducing sugars content was faster at ambient temperature than refrigerated condition. The increase in reducing sugar contents during storage condition due to the hydrolysis of non reducing sugars.

Total sugars The maximum increase in total sugar content was observed at ambient temperature in treatment T₄ from 73.1 to 75.0 % at the end of 90 days storage. Similar trend was observed in refrigerated condition. The increased in total sugar content in mixed toffee might be due to the loss in moisture in both the storage conditions. The increase in total sugar content was reported in banana toffee from 73.7 to 74.1 %, sapota toffee from 73.8 to 74.1 %, guava toffee from 76.1 to 76.5 %, and fig toffee from 74.8 to 75.1 % (Khandekar *et al.* 2005). Similar trend in the content of ascorbic was observed in all toffee samples studied.

Changes in sensory properties of guava and strawberry mixed toffee during storage

Colour and appearance A gradual decrease in score from 8.1 to 7.7, 8.3 to 7.9, 8.2 to 7.8, 8.4 to 8.1 and 8.4 to 8.0 with respect to treatment T₁, T₂, T₃, T₄ and T₅ during 90 days of storage at ambient temperature, while mixed toffees stored in refrigerated condition showed score decreases from 8.1 to 7.8, 8.3 to 8.0, 8.2 to 7.9, 8.4 to 8.2 and 8.4 to 8.1 with respect to treatment T₁, T₂, T₃, T₄ and T₅ (Table 5). The colour deterioration is more in ambient temperature than the refrigerated temperature. This might be the temperature effect on the colour and appearance as well as surrounding environment.

Texture The result on texture score of guava and strawberry mixed toffees decreased gradually from 8.0 to 7.6, 7.9 to 7.6, 8.0 to 7.6, 8.1 to 7.7 and 8.1 to 7.7 with respect to treatment T₁, T₂, T₃, T₄ and T₅ at the end of storage (90 day) at ambient

temperature. Similar trend was observed in refrigerated condition.

Flavour The score for flavour decreases significantly during 90 days storage. The decreases of flavour score was faster in ambient storage than refrigerated storage. This effect is mostly due to the temperature difference in the storage condition.

Taste There was a decline in taste score from 8.1 to 7.6, 7.9 to 7.4, 8.3 to 7.9, 8.6 to 7.9 and 8.6 to 8.1 with respect to treatment T₁, T₂, T₃, T₄ and T₅ at the end of storage (90 day) at ambient temperature. While, the taste score of mixed toffees stored in refrigerated condition decreased from 8.1 to 7.8, 7.9 to 7.6, 8.3 to 8.0, 8.6 to 8.3 and 8.6 to 8.2 with respect to treatment T₁, T₂, T₃, T₄ and T₅. The score for taste decreases significantly during 90 days storage. The decreased rate of taste score was faster in ambient than refrigerated condition. This is due to the temperature effect during storage conditions.

Overall acceptability A gradual decrease in overall acceptability score was observed from 8.1 to 7.7, 7.9 to 7.5, 8.2 to 7.8, 8.4 to 7.9 and 8.2 to 7.8 for treatment T₁, T₂, T₃, T₄ and T₅ respectively at the end of 90 days storage of ambient condition. Similar trend was observed at refrigerated condition. The score for overall acceptability decreases significantly during 90 days storage. The statistical analysis showed that the treatment and storage period had significant effect on overall acceptability content but the interaction was found to be non significant. The overall acceptability was very good for treatment T₄ (70 % guava : 30 % strawberry) than other treatments in both ambient and refrigerated condition at the end of 3 month storage period. This might be due to better score on colour and appearance, texture and taste for the treatment T₄. It was reported that overall acceptability score decreases with respect to storage in banana toffee from 8.7 to 8.3, sapota toffee from 8.6 to 8.4, guava toffee 7.4 to 7.9, fig toffee from 8.6 to 8.1 (Khandekar *et al.* 2005) and tamarind : mango

Table 5 Sensory quality of mixed toffees of guava : strawberry (after 3 months storage)*

Treatment (Guava : Strawberry)	Colour and appearance		Flavour		Texture		Taste		Overall acceptability		Ranks	
	A	R	A	R	A	R	A	R	A	R	A	R
T ₁ =100:00	7.75	7.80	7.73	7.85	7.56	7.67	7.64	7.79	7.67	7.80	4	4
T ₂ =00:100	7.90	8.03	7.48	7.61	7.56	7.61	7.41	7.55	7.52	7.61	5	5
T ₃ =75:25	7.79	7.90	7.75	7.87	7.62	7.73	7.87	8.03	7.80	7.89	2	2
T ₄ =70:30	8.06	8.17	8.05	8.20	7.67	7.86	8.16	8.33	7.99	8.12	1	1
T ₅ =65:35	8.00	8.08	7.88	8.00	7.67	7.80	8.10	8.24	7.83	7.85	3	3
Mean	7.90	8.00	7.78	7.90	7.62	7.73	7.84	7.99	7.76	7.86	–	–
C. D. 5 % (n=10)	0.117	0.026	0.108	0.106	0.127	0.159	0.193	0.212	0.280	0.197	–	–

A Ambient (27±2 oC), R Refrigerated (5±2 oC); * Nine point hedonic scale, Ten semi-trained judges were used for sensory evaluation

blended toffee from 8.4 to 7.1 (Nale *et al.* 2007). The results obtained in present investigation are parallel to the literature.

Microbial quality The results indicated that the standard plate count was directly proportional to moisture content in toffee. Although refrigerated toffee had higher moisture but due to low temperature the microbes could not attack on toffee. The acceptability of the product by the panel members after 3 months storage confirms that the minimum changes which might have occurred due to microbes were within the safe limit for human consumption. Acceptance ranked T₄ first followed by T₃, T₅, T₁ and T₂.

Economics of toffee making The cost of toffee was calculated as per existing prices at the time of the study. The cost of production of mixed toffee ranged from Rs. 121 to 309/kg. These costs did not include rent, transport, sale commission, local taxes etc. These toffees had more prices than other fruit toffees due to higher price of the strawberry fruits.

Conclusion

The results obtained in the present investigation indicated that better quality toffee with guava and strawberry pulps can be prepared by using 70:30%, 500 g sugar, 50 g skim milk powder, 100 g fat, 4 g cocoa powder and 2 g common salt per kg pulp. Guava and strawberry mixed toffee prepared using 70:30 blend gave superior sensory score in respect of quality over other treatments. Toffee could be stored in good condition beyond 90 days at ambient temperature.

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