Studies on preparation of mixed fruit toffee from Fig and Guava fruits

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Abstract Studies were carried out to develop a technology for preparation of mixed fruit toffee from fig and guava fruit pulp and to evaluate the changes in quality of prepared toffees during storage under ambient as well as refrigerated conditions for 180 days. Among the various combinations of fig and guava fruit pulp, toffee prepared from 75:25 w/w (fig: guava) ratios was found better than other combinations in respect to yield, organoleptic properties and nutritional quality. The cost of toffee prepared from higher level of fig pulp i.e. 75:25 (fig:guava) ratio was higher (Rs. 71.84/kg). The storage studies of toffees packed in 200 gauge polyethylene bags indicated that the TSS, reducing and total sugars increased with the advancement of storage period, while moisture and acidity content decreased. The rate of reactions was relatively higher at ambient temperature than refrigerated temperature. Though the sensory quality of toffees also decreased at faster rate during 180 days storage period at ambient condition than the refrigerated condition yet the toffees were found to be acceptable even after 180 days at both the conditions.

Keywords Fig · Guava · Toffee · Mixed fruits toffee

Introduction

Fig (*Ficus carica* L.) belongs to family Moraceae, which is under cultivation since ancient times. In India cultivation of fig is mostly confined to western part of Maharashtra (Pune and Aurangabad), Gujarat, Uttar Pradesh (Lucknow and Shrirangpur), Karnataka (Bellary), Punjab and Tamil-Nadu (Coimbatore). The total area in Maharashtra under fig cultivation is about 1671 ha with the production of 4,118 metric tonnes (Anonymous 2007). The importance of fig fruit as food can hardly be over emphasized. It is a delicious, nutritive fruit and has medicinal properties too (Condit 1951). From the nutritional point of view, fig fruits are much valued and contain high sugars and low acid. The total mineral content is two to four times of other fresh fruits. Both fresh and dry figs contain appreciable amount of Vitamin A, C and small quantities of vitamin B. Fig has laxative properties and used in the treatment of skin infection (Yarosh and Nikonow 1971). It helps to maintain acid and alkali balance of body (Tofu and Tofu 1969). It is also useful in reducing the risk of cancer and heart diseases (Vinson 1999). Fig can be used as fresh, dried, preserved, canned and candied form, the dried form being most popular. In Mediterarian region, it is used for production of wine and alcohol, while in European countries it is used for coffee making.

In India major guava producing states are Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra and West Bengal. It is an important commercial crop in Maharashtra with an area of 5540 ha (Singhal 2003). The fresh guava fruit contains 83 per cent moisture, 1 % protein with an energy value of 67.78 cal/100 g fruit (Singh *et al.* 1976; Pawar *et al.* 1992). The fruit is highly perishable and cannot be stored for longer period. Moreover considerable proportion of the

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produce is lost during post harvest linkage. It is, therefore imperative to develop suitable technology for preservation and processing of such surplus produce. Guava has very strong flavour with higher amount of vitamin C (100–260 mg/100 g) and mineral like phosphorus, calcium etc. Therefore it will be worthwhile to mix guava pulp with other fruit pulp having less flavour to form a combination of both for developing a good quality processed product. Toffee is an important confectionery product. It is reported that pulpy fruits like mango, guava, papaya, fig, jackfruit etc. can be utilized for preparation of toffee (Shastri *et al.* 1979; Singh 1988; Joshi *et al.* 1989; Domale *et al.* 2008). Fruit toffees naturally are very nutritious as they possess most of the constituents of fruit from which they are prepared (Jain *et al.* 1958). However, very little work has been carried out on mixed fruit toffees. This study has been carried out to prepare mixed fruit toffees by combining fig pulp with guava pulp and to evaluate their storage stability.

Materials and methods

Fruits Fully matured fig (Poona fig) and 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 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 ingredients for preparation of fig and guava mixed fruit toffee.

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

Extraction of pulp Ripe fig fruits with firm texture, uniform in size were used for the experiment. The pedicle of ripe figs were removed, fruits were washed under tap water, dried and cut into pieces and were passed through the home scale pulping machine to obtain a fine pulp. Pulp was not strained through muslin cloth to keep seeds in it so as to impart attractive appearance as well as to get feel of presence of fig pulp in the fruit toffee. Selected fully ripened guava fruits were cut into pieces and were passed through the home scale pulping machine to obtain pulp plus seed content. To remove seed the content was poured on screen and rubbed with gentle hand to get fine pulp.

Standardization of toffee recipe Fig and guava mixed fruit toffees were first prepared by using 10 combinations of

different levels of pulp, sugar, hydrogenated fat, skim milk powder and salt (Table 1). The level of ingredients and pulp was finalized by sensory evaluation of toffees by a panel of minimum ten semi-trained judges using 9 point hedonic scale (Amerine *et al.* 1965).

Preparation of toffee Three types of toffees were finally prepared using optimum levels of fig : guava pulp 75 : 25, 50 : 50 and 25 : 75 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 three hours, and then the solid sheet was cut into cubes of 1.5 to 2.5 cm with a stainless steel knife (Parpia 1967).

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 fig and guava mixed fruit 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 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 ($27\pm2^{\circ}\text{C}$) as well as at refrigerated condition ($5\pm2^{\circ}\text{C}$) upto 180 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 $37\pm5^{\circ}\text{C}$ for 48 h for counting bacterial colonies. The colonies were counted with magnifying lens. Total count was taken along with pin point colonies.

Table 1 Different level of pulp and ingredients for standardization of mixed fruit toffees

Treatment No.	Concentration of pulp		Sugar levels g/kg of pulp	Butter fat g/kg of pulp	Skim milk powder g/kg of pulp	Salt g/kg of pulp
	Fig pulp (%)	Guava pulp (%)				
1.	0	100	500	100	50	2
2.	25	75	500	100	50	2
3.	50	50	500	100	50	2
4.	75	25	500	100	50	2
5.	100	0	500	100	50	2
6.	75	25	750	100	50	2
7.	75	25	1000	100	50	2
8.	75	25	500	150	50	2
9.	75	25	500	100	100	2
10.	75	25	500	100	50	4

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

Results and discussion

Recovery of pulp from fruits The recovery of fig pulp was recorded as 995 g/kg of fruit without straining while recovery of guava pulp was recorded as 650 g/kg of fruit. 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 500 g sugar, 100 g butter fat, 50 g skim milk 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 2).

Yield of toffee The yield of fig and guava mixed fruit toffees ranged from 1.220 to 1.210 kg/kg of pulp. 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 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 fig and guava mixed fruit toffees ranged between 8.7–8.8 per cent. There was a significant difference in moisture contents of toffee. The moisture content of fig toffees was recorded within the range of 8.4 to 8.5 per cent. The TSS content of fresh fig and guava mixed fruit toffees ranged between 82.5 to 84.1 °Brix (Table 2). The treatment 75:25 (fig : guava) combination had lower TSS content as compared to the treatment 50 : 50 and 75 : 25 combinations of fig and guava pulp. The TSS was found to increase with increase in the level of guava pulp. The TSS of fig toffee was ranged from 82.5 to 83.7 °Brix. The TSS of guava fruit toffee was ranged from 82.1 to 82.4 °Brix. The TSS of custard apple toffee ranged from 82.4 to 82.8 °Brix. The TSS of tamarind, mango and papaya blended toffee was reported 84.2 to 84.8 °Brix. The titrable acidity of fig and guava mixed fruit toffee ranged between 0.230 to 0.265 %.

Table 2 Yield and chemical composition of fresh fig and guava mixed fruit toffees

Treatment/(Fig:Guava)	Yield (kg/kg of pulp)	Moisture (%)	TSS (°Brix)	Acidity (%)	Reducing sugars (%)	Total sugars (%)
A=75:25	1.220	8.8	82.5	0.23	39.1	77.0
B=50:50	1.218	8.7	83.7	0.24	38.3	76.3
C=25:75	1.210	8.7	84.1	0.26	38.1	75.3
Mean	1.216	8.7	83.4	0.24	38.5	76.2
S.E. ±	—	0.01	0.03	0.03	0.07	0.10
CD at 5 % (n=4)	—	0.04	0.09	0.09	0.21	0.30

The reducing sugar content of fig and guava mixed fruit toffee ranged between 38.1 to 39.1 per cent. The treatment 75:25 combination contains maximum reducing sugars (39.1 %) than other combinations. This difference in reducing sugars content of fresh toffee was might be due to different level of pulps or due to more inversion of added sugar during longer heating of mixture required for preparation of toffees. There was significant difference in the reducing sugars contents of fresh mixed fruit toffee. The reducing sugars content of fresh fig toffee was reported 36.3 to 39.1 per cent. The guava fruit toffee had reducing sugars content in between the range of 40.9 to 41.3 per cent. The total sugars content of fig and guava mixed fruit toffees ranged between 75.3 to 77.0 per cent initially. The total sugars content of fig toffee was reported between 73.6 to 75.8 %. Similarly guava toffee contained 75.1 to 77.2 % total sugars. It was reported that total sugars content of mango toffees was 67.3 %, custard apple toffee 72.2 to 78.9 % and tamarind, mango and papaya blended toffees 55.7 to 60.1 % (Jain *et al.* 1958; Kerawala and Siddappa 1963a, b; Siddappa and Kerawala 1963a, b, c; Dhumal *et al.* 1996; Aruna *et al.* 2000; Khandekar *et al.* 2005; Nale *et al.* 2007).

Sensory properties of fresh fig and guava mixed fruit toffees The score for colour and appearance was 8.6, 8.3 and 8.0 for treatments describe the treatments. The toffee prepared by using 75: 25 % blend (Fig: Guava) scored highest (8.6), while toffee having 25: 75 % blend (fig : guava) scored minimum score (8.0) (Table 3). As level of fig pulp in toffee decreases the score for colour and appearance get reduced. This might be due to faint colour formation by fig pulp, because Poona fig having reddish colour to the fully ripe fruit pulp. The score for texture of fig plus guava mixed fruit toffees were in the average range 8.2 to 8.7 for treatment first second and third. Flavour score for fig and guava mixed fruit toffee ranged between 8.2 to 8.7. There was significant difference in the scores for flavour. The treatment 25:75 (Fig: Guava) blended toffee scored maximum (8.7), while treatment 75:25 blend (Fig : Guava) scored minimum (8.2). The increase in score of flavour is

might be due to increase in guava pulp level in toffees. Fully ripe guava had very strong flavour that contributed to the mixed fruit toffee. This is main reason for higher flavour score to treatment 25:75 % blended toffee than other two treatments. The taste scores for fresh fig and guava mixed fruit toffees were ranged between 8.3 to 8.8. The higher level of fig pulp might be responsible for giving good taste score to the toffee. The lower level of guava pulp might give good combination for taste as well as flavour to the mixed fruit toffee. The sensory score for taste of papaya toffee was 8.1 to 8.4. The score for taste of tamarind, mango, and papaya blended toffees was ranged from 8.0 to 8.8 (Diwate *et al.* 2004; Nale *et al.* 2007). There were significant differences among the treatment for overall acceptability. The mixed fruit toffee of treatment 75 : 25 blend score maximum (8.6), treatment 50 : 50 medium (8.4) and treatment 25 : 75 blend minimum (8.3) for overall sensory scores were recorded. This is might be due to better colour and appearance, texture, flavour, taste and combination of mixed fruit toffees prepared from fig and guava pulp.

Changes in chemical composition of fig and guava mixed fruit toffee during storage The minimum moisture loss of toffee was recorded in treatment 75 : 25 % blend of fig and guava toffee between 8.8 to 7.7 % and from 8.8 to 7.9 % at ambient and refrigerated condition respectively. This might be due to the temperature difference in the storage conditions. The mean of TSS of three toffees prepared from fig and guava mixed fruit pulps increased from 83.4 to 86.4 °Brix at ambient and from 83.4 to 86.0 °Brix at refrigerated storage conditions, respectively (Table 4). There was significant increase in the T.S.S. of toffees in different treatments. At both temperatures the treatment C (25:75) showed maximum increase in T.S.S. followed by treatment “B” (50:50) and treatment “A” (75:25) at the end of storage. The increase in TSS during storage period of mixed fruit toffee might be due to decrease in moisture content during storage. At ambient condition maximum decrease was observed in treatment A from 0.230 to 0.203 % followed by treatment B from 0.240 to 0.209 % and treatment C from 0.265 to 0.224 %. The rate of decrease in acidity per cent was faster

Table 3 Sensory score of fresh toffees prepared from fig and guava mixed pulp

Treatment/(Fig : Guava)	Sensory score ^a				
	Colour and appearance	Texture	Flavour	Taste	Overall acceptability
A=75:25	8.6	8.7	8.2	8.8	8.6
B=50:50	8.3	8.4	8.5	8.3	8.4
C=25:75	8.0	8.2	8.7	8.3	8.3
Mean	8.3	8.4	8.5	8.5	8.4
S.E. $\pm$	0.02	0.01	0.01	0.02	0.04
CD at 5 % (n=10)	0.05	0.04	0.03	0.05	0.12

^aNine point hedonic scale; ten semi-trained judges were used for sensory evaluation Hedonic scale, 9:Like extremely, 8:Like very much, 7:Like moderately, 6:Like slightly, 5:Nither like or dislike, 4:Dislike lightly, 3:Dislike moderately, 2:Dislike very much, 1:Dislike extremely

Table 4 Effect of storage period and pulp combinations on chemical composition of mixed fruit toffee after 6 months storage

Treatment (Fig : Guava)	Moisture (%)		TSS (%)		Acidity (%)		Reducing sugars (%)		Total sugars (%)		Standard plate count (log cfu/g)	
	A	R	A	R	A	R	A	R	A	R	A	R
75:25	7.7	7.9	85.7	85.1	0.20	0.21	40.3	40.1	78.1	77.9	5.8	5.7
50:50	7.6	7.8	86.0	85.6	0.21	0.22	39.3	39.1	77.0	76.8	5.8	5.7
25:75	7.6	7.7	86.4	86.0	0.22	0.25	39.2	38.9	75.9	75.9	5.9	5.8
C. D. 5 % (n=4)	0.03	0.02	0.02	0.03	0.14	0.12	0.05	0.04	0.02	0.14	0.14	0.14

A Ambient (27±°C), R Refrigerated (5±2°C)

in ambient storage than the refrigerated storage. At ambient temperature, maximum increase in reducing sugars content was observed for treatment A from 39.1 to 40.3 %, followed by treatment B from 38.3 to 39.3 % and treatment “C” from 38.1 to 39.2 %. Similar trend was observed in refrigerated condition. 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. At ambient temperature, maximum increase in total sugar content was observed in treatment A from 77.0 to 78.1 % followed by treatment B from 76.3 to 77.0 % and treatment C from 75.3 to 75.9 % at the end of 180 days storage. Similar trend was observed in refrigerated condition. The increased in total sugar content in mixed fruit 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).

Changes in sensory properties of fig and guava mixed fruit toffee during storage A gradual decrease in score from 8.6 to 7.9, 8.3 to 7.8 and 8.0 to 7.5 with respect to treatment A, B and C during 180 days of storage at ambient temperature, while mixed fruit toffees stored in refrigerated condition showed score decreases from 8.6 to 8.1, 8.3 to 7.9 and 8.0 to 7.5 with respect to treatment A, B and C (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. The result on texture score of fig and guava mixed fruit toffees decreased gradually from 8.7 to 7.9, 8.4 to 7.9 and 8.2 to 7.6 with respect to treatment A, B and C at the end of storage (180 day) at ambient temperature. Similar trend was observed in refrigerated condition. The score for flavour decreases significantly during 180 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. There was a decline in taste score from 8.8 to 8.1, 8.3 to 7.7, and 8.3 to 7.7 with respect to treatment A, B and C at the end of storage (180 day) at ambient temperature. While, the taste score of mixed fruit toffees stored in refrigerated condition decreased from 8.8 to 8.2, 8.3 to 7.8 and 8.3 to 7.7 with respect to treatment A, B and C. The score for taste decreases significantly during 180 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. A gradual decrease in overall acceptability score was observed from 8.6 to 7.9, 8.4 to 7.7 and 8.3 to 7.7 for treatment A, B, C respectively at the end of 180 days storage of ambient condition. Similar trend was observed at refrigerated condition. The score for overall acceptability decreases significantly during 180 days storage. The statistical analysis showed that the treatment and storage period had significant

Table 5 Sensory quality of mixed fruit toffees (after 6 months storage)

Treatment/(Fig : Guava)	Colour and appearance		Flavour		Texture		Taste		Overall acceptability		Ranks	
	A	R	A	R	A	R	A	R	A	R	A	R
A=75:25	7.9	8.1	7.8	7.9	7.9	8.1	8.1	8.2	7.9	8.0	1	1
B=50:50	7.8	7.9	8.1	8.1	7.9	7.9	7.7	7.8	7.7	7.8	2	2
C=25:75	7.4	7.5	8.1	8.2	7.6	7.7	7.7	7.7	7.7	7.7	3	3
C. D. 5 % (n=10)	0.06	0.09	0.09	0.08	0.12	0.11	0.12	0.11	0.06	0.05	–	–

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

Hedonic scale, 9:Like extremely, 8:Like very much, 7:Like moderately, 6:Like slightly, 5:Nither like or dislike, 4:Dislike lightly, 3:Dislike moderately, 2:Dislike very much, 1:Dislike extremely

effect on overall acceptability content but the interaction was found to be non significant. The overall acceptability was good for treatment A (75 % fig : 25 % guava) than treatment B and C in both ambient and refrigerated condition at the end of 6 month storage period. This might be due to better score on colour and appearance, texture and taste for the treatment A. The results obtained in present investigation are parallel to the literature (Khandekar *et al.* 2005; Nale *et al.* 2007). 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 6 months storage confirms that the minimum changes which might have occurred due to microbes were within the safe limit for human consumption. The cost of toffee was calculated as per existing prices at the time of the study. The cost of production of mixed fruit toffee ranged from Rs. 62.1 to Rs. 71.8/kg. These costs did not include rent, transport, sale commission, local taxes etc.

Conclusion

The results obtained in the present investigation indicated that better quality toffee with fig and guava pulp can be prepared by using 75:25 per cent pulp, 500 g sugar, 50 g skim milk powder, 100 g fat (cow ghee) and 2 g common salt per kg pulp. Fig and guava mix toffee prepared using 75:25 blend gave superior sensory score in respect of quality over other treatments. Toffee could be stored in good condition beyond 180 days at ambient temperature.

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