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Sucheta
Centre of Food Science and Technology, CCS HAU, Hisar, Haryana, India

Rakesh Gehlot
Centre of Food Science and Technology, CCS HAU, Hisar, Haryana, India

Saleem Siddiqui
Centre of Food Science and Technology, CCS HAU, Hisar, Haryana, India

Raj Bala Grewal
Centre of Food Science and Technology, CCS HAU, Hisar, Haryana, India

Correspondence
Sucheta
Centre of Food Science and Technology, CCS HAU, Hisar, Haryana, India

Development of mixed fruit toffee from guava and mango blends and its quality evaluation during storage

Sucheta, Rakesh Gehlot, Saleem Siddiqui and Raj Bala Grewal

Abstract
The present investigation was carried out to develop mixed fruit toffee from guava and mango pulp blended in different ratios using sugar, commercial glucose, butter and skimmed milk powder. Chemical constituents of guava and mango fruits such as TSS, total sugars, reducing sugars and acidity were found to be (9.6 and 17.76%), (7.10 and 14.51%) (3.60 and 6.08%) and (0.67 and 0.42%) whereas ascorbic acid, carotenoids, pectin and total phenols were analyzed to be (82.5 and 17.5 mg/100 g), (N.D and 2.54 mg/100 g), (0.94 and 0.54%) and (110 and 53.1 mg/100 g), respectively. Total sugars, reducing sugars and browning increased significantly, while ascorbic acid, carotenoids and total phenols decreased significantly in mixed fruit toffee during three months storage. Texture (N) increased significantly during storage period. Toffee prepared from 60 guava: 40 mango blends were highly acceptable. Cost of production of guava-mango toffee was maximum in 0 guava: 100 mango blend and minimum in 100 guava: 0 mango blend.

Keywords: Development of mixed fruit, guava, mango, blends, quality evaluation during storage

Introduction
Guava (*Psidium guajava L.*) belongs to family Myrtaceae which contain about 100 species of tropical shrubs and small trees. Guavas are mainly cultivated in tropical and sub-tropical countries. The fruit contains about four times the amount of vitamin C as present in orange. Guava contains both carotenoids and poyphenols like leucocyanidin, guaijaverin, gallocatechin, the major classes of antioxidant pigments giving them relatively high antioxidant value among plant foods. Guava is also found effective against cancer, bacterial infections, inflammation and pain. A wide variety of value added products can be prepared from this fruit including beverages, jam, jelly, cheese and toffee. Mango (*Mangifera indica L.*) belongs to family Anacardiaceae. Mango pulp contains phytochemicals and nutrients.The composition of edible portion of mango fruit contains: 80% moisture, 63% calories, 0.4% protein, 0.4% fats, 16% carbohydrates, 20% vitamin-A, 3.6% thiamine, 2.5% riboflavin, 2.2% niacin, 20.20% vitamin C, 1.1% calcium and 4.0% iron (Chauhcin and Cahoon, 1987; Rao and Mukherjee, 1989; Haag *et al*., 1990) [6, 17, 8]. Toffees are chewable confectionery items containing sugar, milk solids and butter or vegetable fat as major ingredients (Bhokre *et al*., 2010) [4]. Fruit toffee is a dried pulp with proper amount of sugar and acid mixture. Blending of fruits pulps will result in good combination of taste and nutritive value. These items can find good marketable value in future.

Material and Methods
Uniformly ripe guava fruits were procured from experimental farm, department of horticulture, CCSHAU, Hisar. Uniformly ripe mango fruits were procured from local market for research work. Analytical grade chemicals were purchased from Titan Biotech Pvt, ltd. Sugar, butter and skimmed milk powder were purchased from local market. HDPE (high density polyethylene) bags were used for packaging of products and were also purchased from local market. Fruits pulps were blended in six different ratios (Guava : Mango): 100G:0M; 80G:20M; 60G:40M; 40G:60M; 20G:80M and 0G:100M. Toffee was prepared from the above guava-mango blends by using 1 kg blended pulp, 550 g sugar, 100 g commercial glucose, 80 g butter and 150 g skimmed milk powder as per standard procedure. For preparing toffee, the blended pulp was cooked till its contents became one third of its original volume.

At this stage, required quantities of sugar (550 g), commercial glucose (100 g) and butter (80 g) were added to the pulp and the contents were again cooked until the mass became sufficiently solid and started leaving sides of the pan. Skimmed milk powder dissolved in a little lukewarm water was mixed with the cooking mass and it was again cooked for 2 to 3 minutes. Sodium benzoate @ 500 ppm was mixed with the cooked mass and the product was finally removed from fire and rolled into sheets (0.50 to 0.75 cm thickness) on butter smeared trays and left for 5 to 6 hours for cooling and setting. Toffees of suitable size were cut, wrapped in butter papers and packed in polyethylene bags for evaluating changes in chemical constituents and organoleptic quality at monthly interval during three months storage. Products were analyzed for Total and reducing sugars according to Hulme and Narain, 1931 [10]; ascorbic acid according to AOAC, 1990; carotenoids according to Rodriguez-Amaya (2004), total phenols, non-enzymatic browning and texture according to Ranganna (2014) [16]. Organoleptic evaluation was carried out by semi-trained panelists on 9-point hedonic rating scale as per Ranganna (2014) [16].

Results and Discussion

The fresh guava and mango fruits were analyzed for various physico-chemical characteristics as shown in Table 1. Average fruit weight (126 and 616 g), pulp weight (838 and 695 g/kg fruit), yield of pulp (83.8 and 69.5%), total soluble solids (9.3 and 17.7%), total sugars (7.10 and 14.51%), reducing sugars (3.60 and 6.08%), pectin (0.94 and 0.54%) and total phenols (110 and 53.1 mg/100 g) were recorded for guava and mango fruits, respectively. In mango fruit, carotenoids were recorded as 3.54 mg/100 g. Similar results were reported by Garg *et al*. (1977) [11] in guava, Bashir *et al*. (2003) [3] in guava, Gowda and Huddar (2004) [12] in mango, Kumar *et al*. (2006) in mango, Hegde and Charria (2004) [9] in guava, Bhuyan and Kobra (2007) [5] in mango, Nag *et al*. (2011) [13] in guava and Anupa *et al*. (2012) [2] in guava.

Table 1: Physico-chemical characteristics of fresh guava and mango fruits

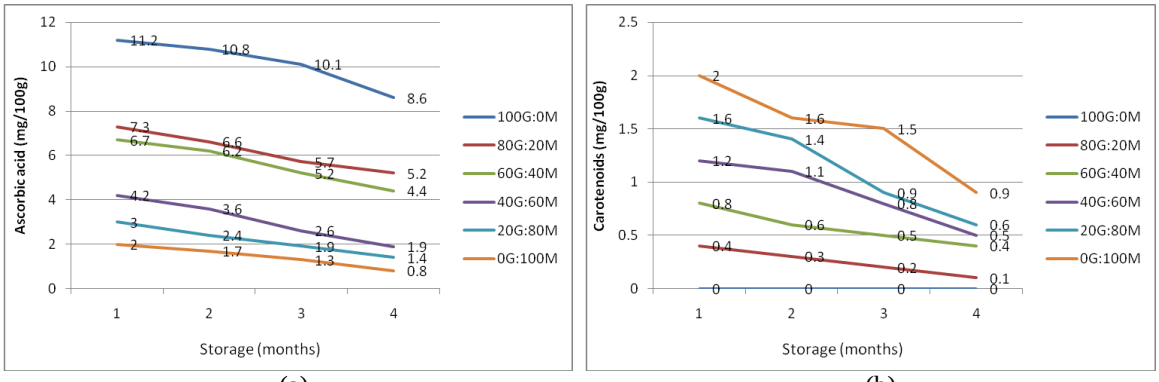
S. No.	Parameters	Guava	Mango
1.	Fruit weight (g)	126±3	616±4
2.	Pulp weight (g/kg fruit)	838±2	695±3
3.	Yield of pulp (%)	83.8±0.2	69.5±0.3
4.	TSS (%)	9.6±0.05	17.8±0.23
5.	Total sugars (%)	7.10±0.07	14.51±0.13
6.	Reducing sugars (%)	3.60±0.01	6.08±0.03
7.	Acidity (%)	0.67±0.04	0.42±0.01
8.	Carotenoids (mg/100 g)	N.D.	3.54±0.15
9	Ascorbic acid (mg/100 g)	82.5±1.37	17.5±0.64
10.	Pectin (%)	0.94±0.08	0.54±0.02
11.	Total phenols (mg/100 g)	110±0.23	53.1±0.17

*The values are mean ± S.D. of three replicates except fruit weight, pulp weight and yield of pulp which are mean ± S.D. of ten replicates, N.D.-Not in detectable amount

Total and reducing sugars (table 2) of mixed fruit toffee increased gradually during storage period. The increase in total sugars might be also due to inversion of sugars as reported by (Deka *et al*., 2004) [7]. Similarly, reducing sugars also increased during storage which might occured due to inversion by hydrolysis. Sivakumar *et al*. (2007) [19] reported slight increase in reducing sugars in guava toffee during storage. Ascorbic acid and carotenoids (fig.1) of mixed fruit toffee decreased significantly during storage. Nayak *et al*. (2012) [14] also reported a decline in vitamin C content in aonla candy which could be due to oxidation resulting in the formation of dehydroascorbic acid. Total phenols decreased and non-enzymatic browning significantly increased (table 3) during storage. This might be due to the reason that phenolic compounds are highly volatile and are easily oxidized to give brown products of high molecular weight. Similar results were reported by Nidhi *et al*. (2008) [15] in bael-guava blended beverages.

Table 2: Effect of storage period on total and reducing sugars of mixed fruit toffee during storage

Treatments (Guava : Mango)	Storage period (months)							
	0	1	2	3	0	1	2	3
	Total sugars				Reducing sugars			
100:0	58.6	58.6	59.4	60.2	7.93	8.29	9.01	9.73
80:20	59.1	59.6	60.8	61.4	8.65	9.37	10.45	10.81
60:40	60.5	60.7	61.5	62.5	10.81	11.17	12.25	12.61
40:60	61.2	62.3	62.8	63.1	11.89	10.81	13.33	13.33
20:80	62.0	63.9	64.2	64.8	12.97	14.42	15.14	15.86
0:100	63.4	64.2	64.7	65.9	15.14	16.94	18.74	20.18
C.D. at 5%	Treatment = 0.78, Storage = 0.64, Treatment × Storage = NS				Treatment = 0.54, Storage = 0.44, Treatment × Storage = 1.08			



(a) (b)

Fig 1: Effect of storage period on ascorbic acid (a) and carotenoids (b) in mixed fruit toffee

Table 3: Effect of storage period on total phenols and non-enzymatic browning of mixed fruit toffee during storage

Treatments (Guava : Mango)	Storage period (months)							
	0	1	2	3	0	1	2	3
	Total phenols				Non-enzymatic browning (O.D. at 440nm)			
100:0	50.1	48.4	47.6	46.2	1.49	1.86	2.09	2.22
80:20	46.4	45.6	44.7	42.1	1.06	1.20	1.98	2.17
60:40	39.3	37.6	36.5	34.8	0.93	1.00	1.83	2.01
40:60	35.2	33.8	32.1	30.0	0.88	0.94	1.51	1.89
20:80	29.2	27.5	25.8	24.3	0.58	0.89	1.37	1.64
0:100	26.6	25.5	23.8	22.0	0.40	0.78	1.23	1.46
C.D. at 5%	Treatment = 0.1, Storage = 0.1, Treatment × Storage = 0.2				Treatment = 0.01, Storage = 0.01, Treatment × Storage = 0.03			

An increase in texture (table 4) of guava-mango toffee was recorded during storage and it may be due to loss of moisture from the product. A significant decrease in colour and appearance, taste, flavour, mouthfeel and overall acceptability of guava-mango cheese and toffee was recorded during three months storage period. Toffee made from blended pulp ratio (60 guava : 40 mango) was found most acceptable. However, organoleptic score of all the blended fruit products remained above the acceptable level even after three months of storage (table 4).

Table 4: Texture and overall acceptability of mixed fruit toffee at the end of storage period

Treatments (Guava : Mango)	Texture (N)	Overall acceptability (on 9-point hedonic scale)
100:0	33.35	6.5
80:20	31.04	7.0
60:40	24.47	7.1
40:60	18.50	6.1
20:80	19.14	6.2
0:100	10.28	6.0

Sivakumar *et al*. (2007) [19] found that guava toffee was acceptable up to 60 days and thereafter, a declining trend was noticed. The colour of the product became darker and its taste and texture was also affected adversely during storage. Similarly, Verma and Chopra (2010) [20] reported that organoleptic score of aonla-mango mixed fruit slab decreased during storage period and the product maintained its acceptability up to seven months at ambient storage. Cost of production was maximum (Rs. 171/kg) in blend (0 guava: 100 mango) and minimum (Rs. 160/kg) in blend (100 guava: 0 mango).

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