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Research Paper

Sensory and nutritional quality of sapota candy

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ABSTRACT : The present investigation was carried at Division of Horticulture, GKVK, UAS, Bangalore during the month of November- March, 2009-2010 to determine the sensory and nutritional qualities of the product *i.e.*, sapota candy developed. Candy prepared using sugar syrup concentration of 30/40/50^{0}Brix dried at 60ºC was judged to be better and so the sample had obtained acceptable sensory scores for colour, flavour, taste and overall acceptability. Osmotic dehydration of sapota slices indicated that the maximum water loss of sapota slices after 72 hours of osmosis at 28^{0}C was 33.6 per cent for sugar syrup concentration of 30/40/50^{0}Brix.The solid gain by sapota slices after 72 hours of osmosis was about 6.36 per cent depending upon the sugar syrup concentration (30/40/50^{0}Brix). Moisture content of the candy was 4.54 per cent, TSS 39^{0}B, pH 5.36 , titrable acidity 0.36 per cent , ascorbic acid 1.92 mg ,total sugar 22.7 per cent , reducing sugar 14.7 per cent and non reducing sugar 8.0 per cent .

KEY WORDS : Sapota candy, Sensory quality, Nutritional quality, Osmotic dehydration

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Sapota [*Manilkara achras* (Mill.)] Fosberg (syn: *Achras zapota* L.), is one of the important tropical fruits of India, although it is the native of South America, has been cultivated in most tropical countries. Sapota fruit is a poor keeper with a shelf- life of about 4-6 days only resulting in gluts in the local markets, bringing down its price considerably.

The research on the utilization of sapota fruits and sapota fruits value added and sapota fruits blended value added products are very scant. Keeping this in view, the present investigation was carried to determine the physical properties of sapota fruits and analyze the nutritional qualities and textural properties of the product *i.e.*, sapota candy developed.

RESEARCH METHODS

Collection of fruits :

Well matured, riped and uniform sized sapotas were used during this study. The fruits were harvested from Horticulture Farm, Division of Horticulture, GKVK, UAS, Bangalore during the month of November- March, 2009-2010.

Physical and bio-chemical properties :

The sapota fruits collected from the tree were analyzed for the following physical characteristics:

Weight of fruit :

The harvested individual sapota fruits were weighed using a digital balance (Make: Essae-Teraoka Private Ltd., Bangalore, India) and the mean weight of ten fruits was expressed as fruit weight.

Seed weight :

The seeds of the sapota were weighed for each fruit using a balance and the mean weight of ten was expressed as seed weight.

Pulp weight :

The pulp of the sapota was weighed for each fruit using a balance and the mean weight of ten was expressed as pulp weight.

Peel weight

The peel of the sapota was weighed for each fruit using a balance and the mean weight of ten was expressed as peel weight.

Fruit size :

The fruit size (length, breadth and thickness) was determined by using a digital vernier caliper and a mean value of ten fruits was expressed as average fruit size.

Fruit shape :

In the identification of the shape of fruit, tracing of the longitudinal and lateral cross sections of the fruit was done and compared with the shapes listed on standard chart. The shape of the fruit was defined by a number on the chart or by descriptive terms.

Fruit colour :

The colour of each sample was measured using Minolta Chroma Meter (Model: CR200b).

Specific gravity :

The specific gravity of the material was estimated by the following formula :

$$\text{Specific gravity} = \frac{W_1}{W_2} \text{xSp.}$$

where,

W_1 = Weight of material in air, kg

W_2 = Weight of displaced water, kg

Sp = Specific gravity of water

Total soluble solids (TSS) :

The TSS of sapota fruits were measured using Erma Hand Refractrometer (Make: Erma Optical works Ltd., Tokyo, Japan).

pH: The pH was recorded using Toshiniwal digital pH meter.

Moisture content :

Sliced sapota fruit (10 g) placed in a stainless steel cups was dried in a hot air oven maintained at $70^0C \pm 2^0C$ for 18 hour (Ranganna, 1995). After drying, the container lid was replaced, cooled in a dessicator and reweighed. The sample was further dried until constant consecutive weights were recorded. The moisture content of samples was calculated using the equation:

$$\text{Moisture content (\%wb)} = \frac{\text{Moisture lost by the sample}}{\text{Initial sample weight (g)}}$$

Development of sapota candy :

Preliminary trails were conducted osmotically with different concentrations of sugar solutions. Based on the feeler trials, the following experimental plan was devised to develop sapota candy:

Experimental details :

***Independent variables* :**

Combinations of sugar solution concentrations for osmotic drying (3 levels) :

– $20/30/40^0$Brix

– $30/40/50^0$Brix

– $40/50/60^0$Brix

Note : $20/30/40^0$ Brix means sapota fruits osmose in 20^0 Brix sugar syrup on first day then in 30^0 Brix syrup on second day and finally in 40^0B syrup on the third day.

Convective tray drying temperature (2 levels)

– 55^0C

– 60^0C

Total treatments (3x2)= 6

Replications = 2

Design = Factorial CRD

Dependent variables :

The six osmo-convective dried final candy products were tested for consumer acceptance in terms of colour, appearance, taste, texture and overall acceptability by sensory evaluation in order to identify one best product.

Methodology of preparing sapota candy :

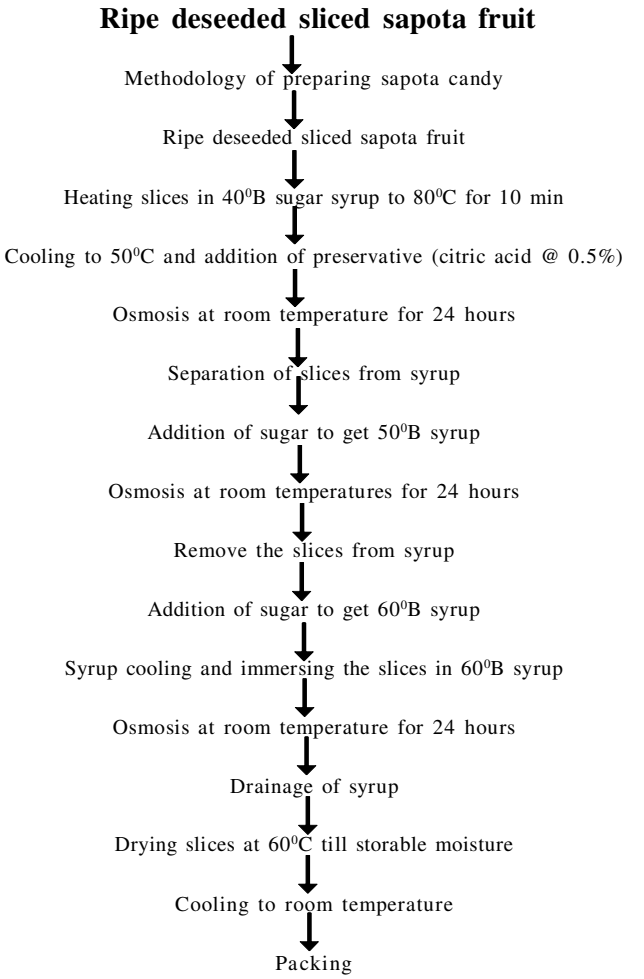

Fig. A : Flow chart for preparation of sapota candy

Table A : Details of treatments employed during the development of sapota candy

Sr. No.	Treatment code	Treatment details	
		Combination of sugar concentration (^{0}B)	Drying temperature (^{0}C)
1.	T_1	20/30/40	55
2.	T_2	20/30/40	60
3.	T_3	30/40/50	55
4.	T_4	30/40/50	60
5.	T_5	40/50/60	55
6.	T_6	40/50/60	60

For clarity, the processing steps were explained using one combination *i.e.*, 40/50/60^0 Brix sugar syrup concentration.

Osmotic dehydration studies of sapota :

***Preparation of sugar syrup* :**

The sugar syrup of desired concentration was prepared by dissolving required quantity of sugar in water, in a vessel. To obtain 40^0 Brix sugar syrup, 450 g of sugar was dissolved in 750 ml of water at room temperature and the contents were heated to 80^{0}C for 10 minutes and the temperature was reduced to 50^{0}C for 10 minutes. An Erma hand Refractometer (make: Erma Optical works Ltd., Tokyo, Japan) was used to ascertain the strength of the syrup before it was filtered using a muslin cloth.

Osmosis of sapota slices in sugar syrup :

Osmotic dehydration characteristics of sapota fruit slices in sugar syrup of selected concentration and temperature were studied by immersing 1 kg of sapota slice by three times its weight of syrup (sample : syrup ratio : 1 : 3) kept in a vessel.

The solid gain and water loss during the osmo-dehydration process was estimated using the equations:

$$\text{Weight reduction}(\%) = \frac{W_2 - W_1}{W_1} \times 100$$

$$\text{Solidgain}(\%) = \frac{[W_3 - W_1 \times \{(100 - ml)/100\}]}{W_1} \times 100$$

Water loss (%) = WR+ SG

where,

W_1=Initial weight of sample, g

W_2= Final weight of sample after osmosis, g

W_3= Oven dried weight of sample after osmosis, g

m1= Initial moisture content of sample before osmosis, %wb

Dehydration studies of osmosed sapota fruit samples :

Osmosed sapota slices were further dehydrated using a tray dryer to obtain shelf stable products. Osmosed sapota slices were dried at 60 ± 2^{0}C in a convective tray dryer (make: Scientek services, Bangalore, India) having thermostat control.

Texture analysis of sapota candy :

Textural properties of sapota candy were studied using a Texture Analyser (Stable Microsystem Ltd., UK). The puncture test was performed for sapota candy using the texture analyser instrument.

■ RESEARCH FINDINGS AND DISCUSSION

The observations on physical characteristics of sapota fruit based on randomly selected fruits are presented in Table 1. The average weight of sapota fruit recorded was 150 g. The average pulp weight of sapota recorded was 79.89 per cent, the peel weight and seed weight were 14.92 per cent and 2.8 per cent, respectively. The fruit had 70.07 per cent moisture and the TSS of the pulp was 21°Brix. pH of the fruit was recorded as 5.3. The average length, breadth and thickness of fruits were found to be 66.68 mm, 51.16 mm and 14.79 mm, respectively and specific gravity of fruit was 1.03 but bulk density and angle of repose result were not encouraging.

Table 1 : Physical characteristics of sapota fruit

Sr. No.	Parameters	Observation
1.	Weight of fruit (g)	150±0.72
2.	Pulp weight (%)	79.89±0.21
3.	Peel weight (%)	14.92±0.19
4.	Seed weight (%)	2.8±0.02
5.	Moisture content (%)	70.07±2.32
6.	Length of fruit (mm)	66.68±3.1
7.	Breadth of fruit (mm)	51.16±2.8
8.	Thickness of fruit (mm)	14.79±2.2
9.	Total soluble solids,TSS (^{0}B)	21±1
10.	pH of fruit	5.3±0.35
11.	Specific gravity	1.03±0.01

The fruit had 70.07 per cent moisture; Similarly, Ramulu Udayasekhara Rao (2003) reported that sapota fruit had 74.47 per cent moisture and 76.2 per cent moisture reported by Gopalan *et al*. (1985), the TSS of the pulp was found to be 21^{0}Brix and pH of the fruit was 5.3. Lakshminarayana, (1980) reported that the 21-24^0 Brix and the pH of fruit was found to be 5.4.

The nutritional quality in terms of different biochemical parameters of sapota fruit is presented in Table 2. The titrable acidity, ascorbic acid, total sugar, reducing sugar and non-reducing sugar were 0.29 per cent, 5.93 mg/100g, 13.88 per cent, 7.96 per cent, and 6.5 per cent, respectively.

Table 2 : Nutritional quality of sapota fruit

Sr. No.	Parameters	Observations
1.	Titrable acidity (% as citric acid)	0.29±0.02
2.	Ascorbic acid (mg)	5.93±0.07
3.	Total sugars	13.88±0.31
4.	Reducing sugars (%)	7.96±0.12
5.	Non-reducing sugars (%)	6.5±0.37

Lakshminarayana (1980) reported that the sapota fruit contains acidity and ascorbic acid as 0.1 per cent and 6 mg, respectively. The total sugar content, reducing and non-reducing sugars were 13.88 per cent, 7.96 per cent, 6.5 per cent respectively. Bhattacharjee (1981) reported that the fruit contained total sugars 24.1 per cent.

The osmotic dehydration characteristics of sapota slices in different concentrations of sugar syrup are shown in Table 3.

Table 3 : Osmotic dehydration characteristics of sapota slices in sugar syrup at 28°C

Sugar syrup concentration (°B)	Moisture content of sapota fruit slices (% wb)		Solid gain (% wb)	Water loss (% wb)
	Initial	Final		
30/40/50	45.52	4.54	6.36	33.6

During osmotic process, the sapota slices were found to lose large amount of moisture. The quantity of water loss was lower depending on osmosis time and sugar syrup concentrations. Maximum water loss of sapota fruit slices was 45.52 per cent after 72 hours of osmosis at 28°C depending on the combination of sugar syrup concentrations 30/40/50° Brix (Table 3).

At any given time, sapota slices lost more water when higher concentration of sugar syrup was used for osmosis.

The effect of sugar syrup concentration on water loss of sapota slices was clearly evident. At any given time, sapota slices lost more water when higher concentrations of sugar syrup were used for osmosis. This is mainly because of increase in osmotic potential when the initial osmotic syrup concentration was increased resulting in higher water loss. Conway *et al*. (1983) observed that every 10 per cent increase in strength, there was a corresponding 5 per cent increase in water loss during osmotic dehydration of apple in sugar syrup. These findings are in agreement with the results obtained by Bongirwar (1997) for osmo-dried banana. The solid gain by sapota fruit slices after 72 hours of osmosis was 6.36 per cent depending upon the sugar syrup concentration of 30/40/50 ° Brix. These findings are in confirmation with results obtained by Dayanand (2003) for jackfruit bulbs.

The treatment T_4 significantly slowed softening of candy. The force required to penetrate the samples *i.e.* average peak force value for fresh sapota fruit was 1050.07 g.

The peak force was observed in treatment T_4 (1050.07 g) followed by T_5 (1110.29 g) with distance 1.79 and 1.93 respectively (Table 4), during ambient condition. The statistical analysis of texture scores of candy products indicated that the products are non-significant.

Table 4 : Effect of different treatments on the texture of sapota candy

Treatments	Ambient storage (25-28°C)	
	Force (g)	Distance (mm)
T_1	1216.19	1.79
T_2	1132.09	1.93
T_3	1222.74	1.78
T_4	1050.07	1.79
T_5	1110.29	1.93
T_6	1136.38	1.81
Mean	1144.62	1.82
F test	NS	NS
S.Em±	118.78	0.19
CD	346.73	0.57

NS= Non-significant

Candy prepared using sugar syrup concentration of 30/40/50°Brix were concluded as best treatment. Thus, one candy sample had the desirable sensory scores of colour (4.6), flavour (4.1), taste (4.5) and overall acceptability (4.3), respectively (Table 5).

Table 5 : Organoleptic scores of sapota candy samples for various sensory attributes

Treatments	Quality parameters			
	Colour/appearance	Flavour	Taste	Overall acceptability
T_1	3.9	3.5	4.0	3.7
T_2	3.4	3.5	3.6	3.6
T_3	3.4	3.2	3.4	3.3
T_4	4.6	4.1	4.5	4.3
T_5	3.0	3.1	3.4	3.3
T_6	3.1	3.6	3.7	3.7
Mean	3.56	3.50	3.76	3.65
F-value	*	*	*	*
S.Em±	0.21	0.19	0.19	0.17
CD	0.61	0.55	0.54	0.50

The best sapota candy selected based on sensory evaluation were analyzed for various nutritional quality parameters and are presented in Table 6.

For candy, the moisture content was 4.54 per cent, the pH and TSS of the candy were 5.36 and 39°B, respectively.

Table 6 : Nutritional quality of selected sapota candy

Constituents	Treatments
Moisture content (%)	4.54 ± 0.09
pH	5.36 ± 0.01
TSS (ºB)	39±3
Titrable acidity (%)	0.36 ± 0.01
Ascorbic acid (mg/100g)	1.92 ± 0.02
Total sugar (%)	22.7 ± 1.23
Reducing sugar (%)	14.7 ± 1.01
Non reducing sugar (%)	8.0 ± 1.12

The titrable quality of candy was 0.36 per cent. The total sugar content was 22.7 per cent, the reducing sugar content and non-reducing sugar content were 14.7 per cent and 8 per cent, respectively.

The ascorbic acid content of candy was found to be 1.92 mg. These findings are similar to the results obtained by Rani and Bhatia (1985) for fresh sand pear candy (ascorbic acid 19.9 mg/100g). Fernandez *et al*. (2007) concluded that the osmotic treatment of muskmelon resulted in decreased vitamin C concentration and water activity as the syrup concentration increased.

Conclusion :

Candy prepared using sugar syrup concentration of 30/40/50^0 Brix dried at 60ºC was judged to be better and so the sample had obtained acceptable sensory scores for colour, flavour, taste and overall acceptability. Osmotic dehydration of sapota slices indicated that the maximum water loss of sapota slices after 72 hours of osmosis at 28^{0}C was 33.6 per cent for sugar syrup concentration of 30/40/50^0 Brix.The solid gain by sapota slices after 72 hours of osmosis was about 6.36 per cent depending upon the sugar syrup concentration (30/40/50^{0}Brix). Moisture content of the candy was 4.54 per cent, TSS 39^{0}B, pH 5.36, titrable acidity 0.36 per cent , ascorbic acid 1.92 mg , total sugar 22.7 per cent , reducing sugar 14.7 per cent and non reducing sugar 8.0 per cent.

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