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***Research Paper***

# Effect of storage on the sensory quality of sapota candy as influenced by different storage methods

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**ABSTRACT :** The present investigation was carried to know the effect of storage on the sensory quality of sapota candy as influenced by different storage methods. The selected candy samples were packed in three different types of packages namely MMPE (metalized multilayered polyethylene) pouches, PP (poly propylene) pouches and polyethene pouches and stored at ambient conditions and refrigerated conditions to study the shelf-life of the candy. The candy from 30/40/50$^0$Brix syrup dried at 60$^0$C and stored in MMPE pouches at ambient condition was judged best by the judges with respect to all the sensory quality parameters. The candy from this treatment had gained relatively higher sensory score for colour (3.4), flavour (3.0), taste (3.4) and overall acceptability (3.5) up to 60 days of storage.

**KEY WORDS :** Sapota candy, Colour, Flavour, Taste, Overall acceptability

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Sapota, one of the important tropical fruits of India, although it is native of South America, has been cultivated in most tropical countries. When the fruit ripes, the flesh is soft, pulpy and granular with sweet and delicious taste. On account of its taste and low cost of production, it is one of the most popular Indian fruits. Generally sapotas are consumed as a table fruit also used for jams, beverages and other such products. Sapota fruits provide 73 K cal and 15.5 g total carbohydrate, 8.2 g of dietary fibre, 0.6 g of proteins and vitamins and minerals (Lakshminarayana, 1980). The research on the utilization of sapota fruits and sapota fruits value added and sapota fruits blended value added products are very scant. Hence, the present investigation was undertaken to know the effect of storage on the sensory parameters of sapota candy.

## RESEARCH METHODS

### Development of sapota candy:

Preliminary trials were conducted osmotically with different concentrations of sugar solutions. Based on the feeler trials, the 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$^0$Brix syrup on the third day.

Convective tray drying temperature (2 levels) :

- 55$^0$C
- 60$^0$C

Total treatments (3x2)= 6
Replications = 2
Design = Factorial Complete Randomized Design

### 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:**

Preparation of sapota fruit candy from deseeded slices was basically a two stage process. First, the sliced fruits were osmotically dehydrated using syrup of selected combinations as given in Table A. For three days to partially remove moisture, the osmosed slices were then dehydrated in convective tray dryer at selected temperature to the final storage moisture level. In each treatment, three concentrations of sugar solutions were employed during osmotic dehydration, step-initially starting with lower concentration and increasing it to designed concentrations in next two days by way of adding additional sugar.

**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 |

The process for preparation of sapota fruit candy is given in flow chart (Fig. A). For clarity the processing steps were explained using one combination *i.e.*, 40/50/60$^0$Brix sugar syrup concentration.

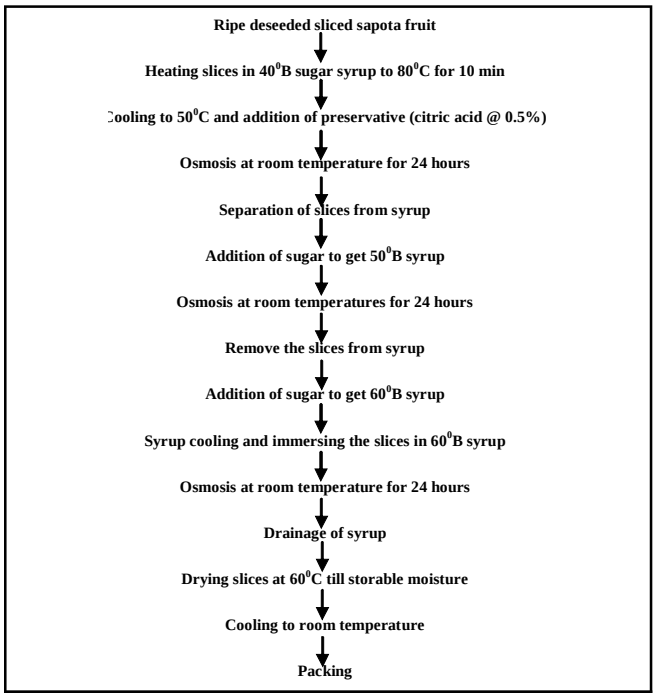


**Fig. A : Flow chart for preparation of sapota candy**

**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:**

To study osmosis, the samples were kept in sugar syrup at room temperature for overnight in a vessel for three days by adding more sugar to increase the strength of the syrup concentration. 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:

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

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

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, per cent 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.

**Sensory evaluation of sapota candy:**

Prepared sapota fruit candies (6 products using different sugar syrup concentration and drying temperature) were evaluated by a panel of 10 judges for sensory attributes such as colour, appearance, taste (aroma and sweetness) and overall acceptability in order to identify the best one sample. Numerical scoring method with maximum 5 point hedonic scale (Amerine *et al*., 1965) was adopted for evaluating the products and the samples were ranked for quality parameters from higher to lower in descending order of acceptability.

**Storage study of sapota candy:**

Out of six different candies prepared, the best one based on texture of candy and sensory scores were considered for storage study. The selected candy samples were packed in three different types of packages namely, MMPE (metalized multilayered polyethylene) pouches, PP (poly propylene) pouches and polyethene pouches and stored at ambient conditions for a period of 90 days to study the shelf-life of the candy. The candy samples stored at ambient temperature were subjected to organoleptic evaluation.

**Statistical analysis:**

The experimental data were analyzed as per the statistical design using the ARIS computer facility of UAS, Bangalore to study the main treatment effects (Sundaraja *et al*., 1972). The limit of probability fixed for the test of significance was P = 0.05

## ■ RESEARCH FINDINGS AND DISCUSSION

The developed six types of candy samples were subjected to organoleptic evaluation (5 point hedonic scale) by trained judges to assess the sensory quality of sapota candy. Table 1 shows the average score obtained by the six candy products for colour or appearance, flavour, taste and overall acceptability. The sensory scores for colour of different candy samples varied from 3.0 to 4.6. The sensory scores for flavour of different candy samples varied from 3.1 to 4.1.The sensory scores of different sapota candy samples for taste varied from 3.4 to 4.5. The sensory scores for overall acceptability of different sapota candy samples varied from 3.3 to 4.3.The highest score of 4.3 was obtained by treatment $T_4$ (the candy prepared using sugar syrup of 30/40/50°Brix and dried at 60°C). The statistical analysis of overall acceptability scores of candy products indicated that the products are significantly different as far as overall acceptability is concerned.

Among six types of sapota candies prepared, best one candy (treatment $T_4$) which had obtained better mean texture and sensory scores were selected for storage study. Thus, 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.

**Sensory score of sapota candy during storage:**

The selected sapota candy samples were subjected to organoleptic evaluation during storage at the end of 30, 60 and 90 days to assess the sensory quality of sapota candy.

**Colour:**

The sensory scores for colour obtained by sapota candy from 30/40/50ºBrix stored in various packages for different lengths of time are presented in Table 2. The colour of scores generally decreased with storage period for all the three treatments. The decreasing trend in scores during storage was remarkable in the candy samples stored in polyethylene pouches. After 30 DAS, in all the treatments there was a considerable reduction in colour scores of candy though the candy stored in MMPE pouches still obtained a highest score of 4.3 and candy stored in polyethylene pouches obtained a least score of 2.0 after 90 DAS which clearly indicated that the product was not acceptable. The difference in sensory scores of difference treatments for colour was significant at 30, 60, 90 DAS.

**Flavour:**

The sensory scores for flavour obtained by candy from 30/40/50ºBrix stored in various packages for different lengths of time are presented in Table 4. The flavour scores generally decreased with storage period for all three treatments. The decreasing trend in scores during storage was remarkable in candy samples stored in polyethylene pouches. After 30 DAS, in all the treatments, there was a considerable reduction in flavour score of candy though the candy stored in MMPE pouches obtained high score of 3.9 but candy stored in polyethylene pouches registered low score of 1.9 after 90 DAS.

**Table 1 : 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.E.± | 0.21 | 0.19 | 0.19 | 0.17 |
| C.D. (P=0.05) | 0.61 | 0.55 | 0.54 | 0.50 |

**Table 2 : Sensory colour score of sapota candy stored in different packages**

| Treatments | Initial | 30DAS | 60DAS | 90DAS | Mean |
|---|---|---|---|---|---|
| $P_1$ | 4.6 | 4.3 | 3.4 | 2.6 | 3.72 |
| $P_2$ | 4.6 | 3.7 | 2.7 | 2.4 | 3.35 |
| $P_3$ | 4.6 | 2.8 | 2.2 | 2.0 | 2.90 |
| Mean | 4.60 | 3.60 | 2.76 | 2.33 | 3.32 |
| | | Packaging | Duration | | Interaction |
| F-value | | * | * | | * |
| SEM | | 0.10 | 0.12 | | 0.21 |
| CD | | 0.29 | 0.34 | | 0.59 |

DAS = Days after storage $P_1$= MMPE pouches $P_2$= PP pouches
$P_3$= Polyethylene pouches * = Significant NS=Non-significant

**Table 3 : Sensory score of sapota candy stored in different packages for flavour**

| Treatments | Initial | 30DAS | 60DAS | 90DAS | Mean |
|---|---|---|---|---|---|
| $P_1$ | 4.5 | 4.3 | 3.4 | 2.3 | 3.62 |
| $P_2$ | 4.5 | 3.4 | 2.2 | 2.0 | 3.02 |
| $P_3$ | 4.5 | 2.9 | 2.2 | 2.0 | 2.90 |
| Mean | 4.5 | 3.53 | 2.60 | 2.10 | 3.18 |
| | | Packaging | Duration | | Interaction |
| F-value | | * | * | | * |
| SEM | | 0.11 | 0.12 | | 0.22 |
| CD | | 0.31 | 0.36 | | 0.63 |

DAS = Days after storage $P_1$= MMPE pouches $P_2$= PP pouches
$P_3$= Polyethylene pouches * = Significant at 5 per cent NS=Non-significant

The difference in sensory score of different treatments for flavour was significant at 30, 60 and 90 DAS. But there was no difference found in interaction of packaging and duration.

**Taste:**

The sensory scores for taste obtained by sapota candy from 30/40/50ºBrix stored in various packages for different lengths of time are presented in Table 4. The taste scores generally decreased with storage period for all three treatments. The decreasing trend in scores during storage was remarkable in the candy samples stored in polyethylene pouches. After 30 DAS, in all the treatments, there was a considerable reduction in taste scores of candy, though the candy stored in MMPE pouches obtained highest score 4.3. The poor taste score of 2.0 for the candy stored in polyethylene pouches after 90 DAS indicated that the product was unacceptable. The difference in sensory scores of different treatments for taste was significant at 30, 60 and 90 DAS.

**Overall acceptability:**

The sensory scores for overall acceptability obtained by sapota candy from 30/40/50ºBrix stored in various packages for different lengths of time are presented in Table 5. The overall acceptability scores generally decreased with storage period for all three treatments. The decreasing trend in scores

**Table 4 : Sensory taste score of sapota candy stored in different packages**

| Treatments | Initial | 30DAS | 60DAS | 90DAS | Mean |
|---|---|---|---|---|---|
| $P_1$ | 4.1 | 3.9 | 3.0 | 2.7 | 3.42 |
| $P_2$ | 4.1 | 3.0 | 2.6 | 2.3 | 3.00 |
| $P_3$ | 4.1 | 2.9 | 2.3 | 1.9 | 2.77 |
| Mean | 4.1 | 3.26 | 2.63 | 2.30 | 3.07 |
| | | Packaging | Duration | | Interaction |
| F-value | | * | * | | * |
| SEM | | 0.12 | 0.14 | | 0.25 |
| CD | | 0.35 | 0.40 | | 0.70 |

DAS = Days after storage $P_1$= MMPE pouches $P_2$= PP pouches
$P_3$= Polyethylene pouches * = Significant at 5per cent NS=Non-significant

**Table 5 : Sensory overall acceptability score of sapota candy stored in different packages**

| Treatments | Initial | 30DAS | 60DAS | 90DAS | Mean |
|---|---|---|---|---|---|
| $P_1$ | 4.3 | 4.2 | 3.5 | 2.9 | 3.72 |
| $P_2$ | 4.3 | 3.3 | 2.7 | 2.1 | 3.10 |
| $P_3$ | 4.3 | 3.0 | 2.1 | 1.9 | 2.82 |
| Mean | 4.3 | 3.50 | 2.76 | 2.30 | 3.21 |
| | Packaging | | Duration | Interaction | |
| F-value | * | | * | * | |
| SEM | 0.12 | | 0.13 | 0.24 | |
| CD | 0.33 | | 0.38 | 0.67 | |

DAS = Days after storage $P_1$= MMPE pouches $P_2$= PP pouches
$P_3$= Polyethylene pouches * = Significant at 5per cent NS=Non-significant

during storage was significantly high in the candy samples stored in polyethylene pouches recorded least score of 2.1 after 60 DAS. After 30 DAS, in all the treatments, there was a considerable reduction in overall acceptability scores of candy though the candy stored in MMPE pouches obtained a highest score of 4.2 The difference in sensory scores of different treatments for overall acceptability was significant at 30, 60 and 90 DAS indicating that MMPE pouches were better than others. But there was no significant difference found between packaging and duration.

The quality parameters like colour, flavour, taste and overall acceptability of saptoa candy as judged by panelists revealed that candy was moderately acceptable up to 60 days of storage. The extent of physico-chemical and sensory changes during storage of processed products depend on the kind of fruit used for preparation, ingredients, preservative mode of processing and storage conditions (Paull, 1979).

The candy stored in MMPE pouches was better with respect to colour, flavour, taste and overall acceptability as compared to sample in PP pouches or polyethylene pouches. Significant differences were found with respect to colour or appearance, flavour, taste and overall acceptability. The texture of candy stored in MMPE pouches was good and no shriveling was observed. The colour or appearance of candy was good in terms of glossiness since the candy prepared in high sugar strength had absorbed little more sugar and this sugar imparts glossy appearance to the candy. The candy from 30/40/50$^0$Brix sugar syrup strength was ajudged the best with respect to appearance. Addition of little citric acid during candy preparation prevents the crystallization of sugar as sugar crystallization affects the appearance of the candy. Flavour is mainly due to sugar and addition of sugar can improve flavour intensity in canned papaya (Mabes *et al*., 1982). Decrease in organoleptic scores of candy during storage was observed by Anjali *et al*. (2005) in lemon peel candy and Sharma *et al*. (1998) in apple candy.

The candy from 30/40/50$^0$Brix syrup dried at 60$^0$C and stored in MMPE pouches was judged best by the judges with respect to all the above quality parameters. The candy from these treatment combinations had gained relatively higher sensory score for colour (3.4), flavour (3.0), taste (3.4) and overall acceptability (3.5) up to 60 days of storage. Decrease in mean scores of various organoleptic characters like colour or appearance, flavour, taste and overall acceptability may be due to ageing of the product.

**Conclusion:**

The candy from 30/40/50$^0$Brix syrup dried at 60$^0$C and stored in MMPE pouches was judged best by the judges with respect to all the sensory quality parameters. The candy from these treatment combinations had gained relatively higher sensory score for colour (3.4), flavour (3.0), taste (3.4) and overall acceptability (3.5) up to 60 days of storage. Decrease in mean scores of various organoleptic characters like colour or appearance, flavour, taste and overall acceptability may be due to ageing of the product.

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