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Processing of Sapota (Sapodilla): Powdering

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Abstract: Sapota (Achras Zapota), a tropical fruit, was processed into a value-added powder and evaluated for use in traditional Indian recipes. Fruits of sapota (cv, *kalipatti*) were halved, quartered, or sliced 5 mm thick; dried at 55, 60, 65 and 70°C in convection and vacuum ovens; then ground to pass through a 105μ sieve. Total soluble solids, acidity, ascorbic acid and overall quality were highest when dried at 65°C. The powder was incorporated, at 20% by weight, into five traditional Indian recipes. Sapota's natural color, aroma and flavor were retained. The best overall results were obtained in coconut burfi, banana milk shake and banana shikarani.

Key words: Sapota, sapodilla, powder

INTRODUCTION

Of all the fruit produced and processed in India, nearly 30% is wasted due to improper post harvest handling, transportation and storage. Research data are abundant on organizing systems such as grading, cleaning, packaging, cold storage and distribution. The ultimate aim in fruit processing is to increase shelf life. Methods such as controlled atmosphere storage, modified atmosphere storage and dehydration are typical. Of these methods, dehydration is a cost-effective and viable method.

Sapota (*Achras zapota*) is a tropical fruit belonging to the Sapotaceae family, on which few studies have been done. The most common cultivars grown are *Kalipatti, Chaatri, Dhola Diwani, Long, Bhuri/Bhuripatti, Jingar, Venjet, Pala, Kirtha bharthi, Dwarapudi, Jonnavalasa Round, Cricket Ball, Oval, Bangalore* and *Calcutta Round.* Mature fruits are used in jams and provide a source of raw material for the manufacture of industrial glucose, pectin and natural fruit jellies. Ripe sapota is eaten as a dessert fruit and also is canned. Only the pulp is usually consumed, although the skin is richer in nutritive value[1].

An average sapota tree yields between 250-2500 fruits, depending on its age. Mature fruits contain about 72 to 78% moisture content (wb) and total soluble solids (TSS) values range from 12 to 18 °Brix. Because fruits are easily bruised, most harvesting is done by hand.

Changing lifestyles and values in India have affected eating habits considerably. There is a strong demand for convenience foods. Meanwhile, per capita expenditures on food have not increased significantly[2]. The sale of powder concentrates was $ 1.47 million in 1985, accounting for about 53% of soft drink concentrate sales in India. In response to the demand for powder concentrates for the fast food and convenience food industries, this study was conducted to investigate the feasibility of converting the dried sapota into a value-added product.

Sapota remains a mostly unexplored fruit, although research has been reported on aspects of its post harvest treatment. Studies have been reported on the extension of shelf life of the fruits by chemical treatments. Broughtan and Wong[3] determined the optimum storage temperature for sapota for a period of 2 wk could be as high as 18-20°C. Ali, Rhaman and Mathad[4] reported sapota was susceptible to bruise damage, hence a suitable packaging system was required for handling and transportation. Banik, Dhua, Ghosh and Sen[5] reported that fruits kept at 10-20°C in polyethylene bags with permanganate-silica-gel could be stored up to 18 d with minimum spoilage and those treated with naphthalene acetic acid (NAA) and coated with paraffin wax retained good quality for up to 12 d. Gautam and Chundawat[6] reported that dipping sapota in Gibberlic Acid (GA), kinetin or $AgNO_3$ extended the ripening period of fruits. Shelf life was limited to 15 d regardless of the storage method tested in those studies.

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No reports on the processing of sapota into value added products were found.

One way to increase the shelf life of sapota would be to process it into powder, as is done with various other fruits. Purthi[7] conducted a study on mango processing, using an atmospheric double drum drier and adding corn meal and tricalcium phosphate to improve the powder's flow characteristics. Bhalerao and Mulmulney[8] studied dehydration of citrus pulps and their use as an adjunct for dry beverage mixes by means of fluidized bed drying and osmotic drying. Lal, Genzalez and Wesali[9] freeze-dried banana powder. Phanindra, Jayathilakan and Vasundhara[10] reported on powder preservation of pineapple juice. Dried powder can be stored much longer than fresh fruit. After studying various aspects of sapota, we decided to explore the possibilities of powdering it.

Objectives of this study were to transmute the dried sapota into powder form and study the incorporation of powder into various traditional dishes. The drying aspects were reported in the first part of this study[11]. Powdering dried sapota and its incorporation into various local dishes are reported herein.

MATERIALS AND METHODS

Sapota (*cv., Kalipatti*) fruits were harvested from the orchard of Agricultural College, Raichur, India. Initial moisture contents ranged from 72-78 (% wb) were used in the studies. Fruits of similar size were selected. Typical chemical composition of the fruit is shown in Table 1. The physical properties of the selected fruits are shown in Table 2. The selected fruits were washed with tap water and then ripened for 2-3 d in a cardboard box. They were washed again with tap water and finally with distilled water, before processing.

Sample Preparation: The outer skin of the ripened fruit was peeled off manually using a knife without damaging the pulp. The fruit was subjected to sulphitation before drying to prevent fungal infection and to maintain its color. An appropriate number of 300 g samples were weighed, dipped in a 1% potassium metabisulphate (KMS) solution for 3 min and then drained.

Drying of Sapota Fruits: Pretreated peeled sapota fruits were cut into halves, quarters and 5 mm thick slices. Samples were dried in a convection oven (Kumar Lab Oven, 1984, CLS 6302, 50 to 250°C) and in a vacuum oven (with 25 mm Hg vacuum) (Lawrence and Mayo 1984, 760 mm Hg, 1.3 kW, 49 to 150°C) at temperatures of 55, 60, 65 and 70°C. The experiments were triplicated for each treatment.

Table 1: Composition of ripe sapota fruit*

Constituents	Approximate Amount
Moisture content % (w.b.)	73.37
Protein (g)	0.70
Fat (g)	1.10
Minerals (g)	0.05
Fiber (g)	2.60
Carbohydrates (g)	21.40
Energy (cal)	98.00
Phosphorous (mg)	72.00
Iron (mg)	1.25
Calcium (mg)	28.00
Thiamine (mg)	0.02
Riboflavin (mg)	0.03
Carotene (mg)	97.00
Ascorbic acid (mg)	0.06

*/100 g of edible portion

Table 2: Physical properties of sapota fruit

Parameters of fruits	Minimum	Maximum	Average
Diameter (cm)	4.60	5.40	4.80
Weight (g)	74.90	78.00	76.40
Surface area (cm^2)	63.60	95.00	79.30
Volume (cm^3)	47.70	87.10	67.40
True Density (g cm^{-3})	1.12	1.56	1.34
Bulk density (g cm^{-3})	0.80	0.83	0.815

Table 3: Ingredients used in sweet products

Sample No.	Product	Ingredients
1	Coconut burfi	Fresh coconut, sugar, sapota powder
2	Milk shake	Milk, sugar, sapota powder
3	Ice cream	Milk, ice cream powder, sugar, sapota powder
4	Rava laddu	Rava, sugar, ghee, sapota powder
5	Banana milk shake	Banana, sugar, milk, sapota powder

Powdering of Dehydrated Sapota: The dehydrated sapota samples obtained at different drying temperatures were ground in a mixer grinder (Maharaja, 1990, Classic, 600 Watts, ½ kg) and further reduced in a ball mill (Marco Scientific Works, New Delhi, 1984, MSW-343, 1 kg, ½, hp motor, 80 rpm) to pass through a 105μ sieve.

Chemical Analysis of Fruit and Powder: The Total Soluble Solids (TSS), acidity and ascorbic acid content of sapota fruit before and after dehydration, were determined. TSS of sapota was determined using an Abbey hand refractrometer and expressed in terms of °Brix[12].

Raw fruit were cut into pieces. The juice was extracted and placed on the prism cover of the refractrometer. TSS values (°Brix) were read directly by viewing through the eyepiece. This procedure was repeated 3 times for each sample.

A 2 g dried and powdered sample was mixed with 2 mL of water. The clear juice was filtered using muslin cloth. A drop of the extracted juice was placed on the prism cover of the refractrometer and the TSS value was read directly by viewing through the eyepiece. This was

repeated 3 times for each sample.

About 10 mL of clear juice was extracted and diluted with distilled water to 100 mL (1:10). From this an equilate of 25 mL was placed in a conical flask and 2 to 3 drops of phenolphthalein indicator were added. This was titrated against 0.1 N NaOH until the color changed to light pink and persisted. The titered value was recorded. Three readings were taken for each of the samples and acidity was calculated as

$$\% \text{ of titrable acidity} = \frac{\text{Titer value x 0.1x64} \quad \text{x 100}}{\text{Titer value x 0.1x64} \quad \text{x 100}} \times 100 \quad (1)$$

The acidity of the powder was determined in the same way as was the raw fruit.

The reagents used for the ascorbic acid content determination were oxalic acid, 2-6 dichlorophenol-indophenol dye, ascorbic acid and sodium water.

Sodium bicarbonate (21 mg) was dissolved in distilled water and the volume increased to 100 mL. A stock standard solution was prepared by dissolving 50 mg of ascorbic acid in an oxalic acid solution. Then, the volume was made up to 50 mL in a volumetric flask. This solution contained 1mg of ascorbic acid/mL.

A working standard solution was prepared by diluting 10 mL of stock standard solution in 100 mL with oxalic acid. This solution contained 100 $\mu gm\ mL^{-1}$. About 5 mL of the working standard solution were placed in a 100 mL conical flask and 5 mL of oxalic acid were added to it. The mixture was titrated against 2-6 dichlorophenol indophenol dye in the burette until a pink end point was obtained and persisted for 5 min. The burette reading, V_1, was noted. The amount of dye consumed was equivalent to the amount of ascorbic acid present in the conical flask.

A 5 g sample of juice was extracted in oxalic acid, filtered and then made up to 100 mL with oxalic acid. About 5 mL filtrate were pipetted in a conical flask and 5 mL of oxalic acid were added and titrated against the dye to the pink end point. The burette reading, V_2, was noted. The ascorbic acid content (mg/100 mg) was calculated as

$$\text{Ascorbic Acid} = \frac{\dfrac{\text{Ascorbic acid (mg) content in std. Stock solution}}{\text{wt. of sample (g)}}}{\dfrac{\text{T otal sample volume (mL)}}{\text{5 mL of equilate of juice}}} \times 100 \quad (2)$$

Sensory evaluation of sapota powder incorporated in sweet products: To evaluate its acceptability, the sapota powder was incorporated at 20% by weight into coconut burfi, milk shake, ice cream, rava laddu and banana milk shake (Table 3). Color, appearance, taste, texture and flavor were evaluated on a 5-point scale[13], by a panel of 10 judges in the Dept. of Foods and Nutrition, College of Rural Home Science, University of Agricultural Sciences, Dharwad, India. The quality parameters were quantified and the mean scores of the 10 evaluations were calculated.

RESULTS AND DISCUSSION

The initial moisture contents of the fresh fruits were 72-78 (% wb). The TSS, % acidity and ascorbic acid content of the fresh fruits ranged between 12 to 18°Brix, 0.31 to 0.35% and 0.5 to 0.78 mg/100mg of pulp, respectively.

The diameter, weight, surface area, volume, true density and bulk density of the sapota fruits were determined (Table 2).

Samples obtained at each drying temperature were ground so that 80% of the particles passed through a 105μ sieve. Each sample was packed separately and sealed in polyethylene pouches using a pack sealer.

The powders varied in color and aroma. The powders dried at 55 and 60°C turned light brown, but the powders dried at 65 and 70°C retained their original color. The powder dried in a vacuum oven at 65°C retained more color and aroma than the others. The powder dried at 70°C were discolored significantly[14].

Composition of Sapota Powder: Changes in TSS, % acidity and ascorbic acid content were analyzed. Beginning TSS values varied from 12 °Brix to 18 °Brix and increased to 22-28 °Brix in the dried powder (Table 4). TSS was highest when dried in a vacuum oven at 65°C. Increased TSS also corresponded with higher concentrations of sugars.

The percentage acidity of the fresh fruit was 0.37 to 0.38% whereas in the powder it was 0.24 to 0.35%, indicating a decrease in percentage acidity after dehydration. The percentage acidity decreased as drying temperature increased (Table 5).

Ascorbic acid contents of the fresh fruit were 0.55 to 0.78 mg/100 mg and increased to 0.93 to 1.85 mg/100gm in the powder. Comparisons of ascorbic acid contents of powders dried at different temperatures are presented in Table 6. Form the chemical composition analysis it was found that powder obtained from samples dried at 65°C was the more acceptable. Further, the powder from samples dried in vacuum oven had higher values of the chemical constituents analyzed, suggesting vacuum oven method to be better than the convection oven.

Table 4: Total soluble solids (°Brix)* of the sapota powders obtained from samples dried at different temperatures (+/- 1.0)

Sample No.	Temperature (°C)	Convection oven			Vacuum oven		
1	55	19	20	21	20	19	21
2	60	20	22	22	21	20	22
3	65	25	22	23	24	25	26
4	70	21	21	23	24	23	21

*Initial T.S.S. values of ripe fruit were 12 to 18 °Brix

Table 5: Percentage acidity* of sapota powders obtained from samples dried at different temperatures (+/- 0.02%)

Sample No.	Temperature (°C)	Convection oven			Vacuum oven		
1	55	0.33	0.31	0.33	0.33	0.32	0.34
2	60	0.32	0.12	0.30	0.32	0.35	0.30
3	65	0.27	0.26	0.25	0.28	0.27	0.26
4	70	0.24	0.26	0.24	0.25	0.16	0.24

*Initial values of percentage acidity were 0.33 to 0.35%

Table 6: Ascorbic acid content of sapota powder obtained from dried samples as different temperatures of drying (+/-0.05)

Sample No.	Temperature (°C)	Convection oven			Vacuum oven		
1	55	0.74	0.81	0.76	0.74	0.81	0.79
2	60	0.93	0.89	0.87	0.74	0.74	0.83
3	65	1.11	1.23	1.12	1.48	1.23	1.31
4	70	1.24	1.43	1.28	1.85	1.67	1.95

Sensory Evaluation of Sapota Powder Incorporated Sweet Products: Sapota powder was incorporated at 20% (w/w) in coconut burfi, milk shake, ice cream, rava laddu and banana milk shake. These products were evaluated for appearance, color, taste, texture, flavor and overall acceptability.

The mean score for appearance ranged from 3.4 to 4.5. Coconut burfi had the highest score and ice cream had the lowest score. The mean score for color ranged from 3.5 to 4.5. Coconut burfi and banana milk shake had the highest score and ice cream had the lowest score. Taste scores ranged from 3.8 to 4.5, with the highest for coconut burfi and the lowest for ice cream. Texture scores ranged from 3.0 to 4.5, with the highest for coconut burfi and the lowest for ice cream. Flavor scores ranged from 3.0 to 4.0. The highest-rated flavors were received for coconut burfi and banana milk shake and again, the lowest for ice cream.

Overall scores ranged from 3.4 to 4.5. Ice cream had the poorest acceptability score. Coconut burfi had the highest acceptability, followed by banana milk shake and rava laddu.

Among the sensory qualities evaluated, the mean values of the scores of all the products ranged from 3.61 to 4.26. Taste was highly acceptable, as were color and appearance. Texture was the major sensory quality affected negatively by the addition of the powder. Sapota powder did not mix well in ice cream and milk shake giving them a slightly gritty texture.

However, sapota powder incorporated well into coconut burfi, rava laddu and banana milk shake, especially when texture was not a major factor and contributed favorably to taste, color and appearance.

CONCLUSIONS

Sapota (cv, *Kalipatti*) with initial moisture contents ranging between 72-78% (w.b.), were dried in a convection oven and vacuum oven (25mmHg vacuum) and the drying characteristics determined. The dehydrated product was powdered using a grinder and a ball mill. The TSS, % acidity and ascorbic acid content of the powdered fruits were determined.

The dried pulp was reduced in size so 80% of the powdered product passed through a 105 μ sieve. TSS of the fresh fruit was in the range of 12°- 18 °Brix and increased to 20°-26 °Brix after dehydration. Ascorbic acid content of the fresh fruit was in the range of 0.55 to 0.78 mg/100 g of pulp and increased to 0.93 to 185 mg/100 g in the dehydrated powder. Percentage acidity values decreased as drying temperature increased. The original flavor and color were retained in the dehydrated powder. Sapota powder obtained from the fruits dried at a temperature of 65°C retained the most original flavor and color. The increases in ascorbic acid and T.S.S. were highest at 65°C. Furthermore, the product dried in the vacuum oven was superior to that obtained from the convection oven. The best drying temperature was found to be 65°C. Incorporation of the powder in coconut burfi, banana milk shake, banana shikarani and rava laddu was found to be acceptable by sensory analysis.

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