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Preparation of Jam from Sapota *(Achras zapota)*

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Abstract

An attempt was made to develop sapota jam to assess its prospect in marketability. The fruits were collected from local market and the pulp was extracted in the laboratory. Then the pulp was analyzed monthly for proximate composition. The proximate analysis of sapota pulp showed moisture 70.07%, ascorbic acid 8.90 mg/100g, pH 5.10, TSS 19.4% and total sugar 16.07%. No special change of ingredients was found during two months of storage. But, a little change was observed after four months. The products (jam) with three different formulations (50%, 75% and 100% pulp of the standard formula) were prepared. Sodium benzoate was added as preservative in a required quantity. These products were packed in appropriate container. A taste panel consisting 10 panelists adjudged the acceptability of the samples. The consumers' preferences were measured by statistical analysis. Among the samples, jam made with 75% pulp of the standard formula (sample A_2) was adjudged the best product by the panelists.

Keywords: **Jam, sapota, ascorbic acid, sugar, *Achras zapota***

1. Introduction

Sapota, (*Achras zapota* or *Manilkara zapota)* is a delicious fruit introduced from tropical America. It is also known as sapodilla or *chiku* in India, which is mainly cultivated for its fruits. While in South-East Mexico, Guatemala, British Honduras and other countries chuckle is commercially produced. The unripe fruit and bark yield milky white latex which solidifies on exposure to air and this forms the base for making chuckle. Chuckle is commercially produced in South East Mexico, Guatermala and British Honduras. Immature fruits are astringent, while ripe fruits are sweet smelling and delicious. The mature fruits are also used for making mixed jams and they provide a valuable source of raw material for the manufacture of industrial glucose, pectin and natural fruit jellies. They are also canned as slices (Sulladmath and Reddy, 1985)

The fruit is a berry with a scurfy brown peel. Fruit may be round to oval-shaped or conical, 2 to 4 inches (5-10 cm) in diameter and 2.6 oz to 2.2 lbs (75 to 1000 g) in weight. The pulp is light brown, brownish yellow to reddish brown, with a texture varying from gritty to smooth. The pulp has a sweet to very sweet (19-24^0 Brix), pleasant flavor. Seed number varies from 0 to 12. Seeds are dark brown to black, smooth, flattened, shiny, and ¾ inch (1.9 cm) long. When fruit reaches maximum size, it may be picked and allowed to ripen off the tree. From experience, one can judge maturity of fruit of a particular variety or selection by its size and appearance (Balerdi *et al.* 2005).

Sapodillas are nutritious and mostly eaten as fresh fruit. Sherbets, milk shakes and ice cream can be made from fresh pulp. Chicle, the latex obtained from the bark of the tree, was for many years the principal ingredient of chewing gum. Because of their beauty and tolerance to neglect, Sapodilla trees may also be used as an ornamental for landscaping (Balerdi *et al*. 2005). The pulp is also made into sherbet and halwa.

Sulladmath and Reddy (1985) also mentioned that, Sapota fruits are a good source of sugar which ranges between 12 to 14%. The constituents in ripe Sapota fruits per 100 g of edible portion are: moisture 73.7g, carbohydrate 21.4g, protein 0.7g, fat 1.1g, calcium 28 mg, phosphorous 27mg, iron 2mg and ascorbic acid 6mg, glucose ranged from 5.84 to 9.23%, fructose 4.47 to 7.13%, sucrose 1.48 to 8.75%; total sugars 11.14 to 20.43%, starch 2.98 to 6.40% and tannin content varied 3.16 to 6.45% because of the skins.

According to Morton (1987) the constituents in ripe Sapota fruit are: moisture 69.0 to 75.7%, ascorbic acid from 8.9 to 41.4 mg/100g, total acid 0.09 to 0.15%, pH 5.0 to 5.3, total soluble solids 17.4º to 23.7º, Brix; as for carbohydrates.

Desrosier (1963) stated that preservation of fruits by manufacturing jam and jelly is a recognized practice throughout the world. Jam and jelly from the pulp and juice respectively are prepared by adding sugar, pectin, citric acid after concentrating by evaporation to a point where microbial spoilage is prevented. The products are stored without hermetic sealing by covering with paraffin on the air surface.

Guichard *et al*. (1991) investigated the composition of headspace, consistency, taste and flavor characteristics in jams made with different pectin. At usual concentration higher methoxylated pectin induced an undesirable modification of typical flavor and intensity of flavor and taste, whereas low methoxylated pectin induced few alternations. A fixed concentration and molecular weight, a disease in degree of esterification, produced a significant disease in consistency and noticeable modifications of the flavor perception but not taste alteration. Mechanical reduction of pectin molecular weight significantly modified only the consistency.

Wards and Aurand (1977) reported that ascorbic acid (Vitamin C) was very susceptible to oxidation. Alkalis, iron and copper salts, heat, oxidative enzymes, air and light accelerated its destruction. It is readily preserved in acid media, but it disappeared rapidly when heated in neutral and alkaline media, certain enzymes destroyed ascorbic acid as a result.

Processed sapota products are rarely available in our markets and very little work has been done on processing of sapota in our country. Food processing industries are in developing stage in Bangladesh and consumption of processed fruit products is gradually becoming popular. A number of locally processed fruit products are now available in the market. If quality products from sapota are developed, it might be welcomed by the consumers who have affinity for sapota round the year.

In view of the above, attempts were made to explore the possibility of using sapota fruit for the preparation of good quality jams and their market acceptability. The specific objectives of this study were as follows:

1. To analyze the proximate composition of sapota and to develop jam.
2. To assess the shelf life and acceptability of the product.

2. Materials and Methods

The experiment was conducted in the laboratory of "Department of Food Technology and Rural Industries" Bangladesh Agricultural University, Mymensingh. The sapota, *Achras zapota* (Family: Sapotaceae) was collected from the local market. The major ingredients used were sugar, citric acid, pectin and sodium benzoate.

2.1. Extraction of sapota pulp

The fully ripe healthy and fresh sapota was washed thoroughly with potable water and the skin was removed by a knife. The seeds were removed and then sapota fruit was blended by a blending machine. The pulp thus obtained was preserved by freezing.

2.2. Chemical analysis of sapota pulp

The method described in AOAC (2000) for determining moisture in sapota products was used where the temperature was maintained at 100-150 ^{0}C for 24 hours. Temperature of drying was reduced because fruit sugars are mainly fructose which might be decomposed to a great extent when heated to 100 ^{0}C and may give an unrealistic value of moisture content. The acidity was determined by titration using standard sodium hydroxide solution and expressed as anhydrous citric acid and pH was measured by a pH meter. The ascorbic acid content in the products was estimated by titrimetic method as summarized by Rangana (1979) using 2-6, dichlorophenol dye and sugar by Lane and Eynon (1923) method. Ash content of the products was determined by the method was described in AOAC (1984).

2.2.1. Total soluble solids (TSS)

Total soluble solids (TSS) was determined by the method described by Rangana (2003). Sugar content of the samples was determined according to the method of Lane and Eynon (1923).

2.2.2. pH

pH meter was used to determine the pH using the method described by Covenin (1984).

2.2.3. Vitamin C content

Vitamin C was measured according to Rangana (2003).

2.2.4. Processing of sapota jam

Four hundred fifty gram sapota pulp or filtered sapota juice, 550 g sugar, 5 g pectin and 5 g citric acid was used to make 1 kg sapota jam. At first pectin was mixed with sugar in a stainless steel pot, after that the sapota pulp or juice was poured in to that pot and agitated. Then heating was done by a gas burner until TSS became nearer to 65%. At that time citric acid was added. Heating was stopped when TSS became nearer to 67% then. Lastly, bottling and parafinning was done.

2.3. Storage studies

Processed sapota jam was stored at ambient temperature (27 ^{0}C to 34 ^{0}C) for a period of 4 months and quality parameters like the changes in TSS, acidity, pH, color, flavor, texture and vitamin C and visual fungal growth were observed. The analyses of the parameters were done according to standard analytical methods summarized by AOAC (2000) and Rangana (2003).

2.4. Statistical analysis

The experimental data were statistically analyzed by Randomized Complete Block Design (RCBD) using MSTAT statistical software in a microcomputer. The mean values adjusted by Duncan's Multiple Range Test (DMRT) (Duncan, 1951).

3. Results and Discussion

The results of various experiments conducted during the study period are summarized below:

3.1. Composition of sapota pulp

The composition of fresh sapota pulps such as moisture, TSS, reducing sugar, non-reducing sugar, total sugar, ash, pH, acidity and vitamin C content as recorded in the present study in Table 1. The results obtained are in good agreement with those of Morton (1987).

Table 1. Chemical composition of fresh sapota pulp

Components/ Parameters	Present in sapota pulp	Components/Parameters	Present in sapota pulp
Moisture (%)	70.07	Ash (%)	01.40
TSS (%)	19.4	pH	05.10
Reducing sugar (%)	04.96	Acidity (%)	00.15
Non-reducing sugar (%)	11.11	Vitamin-C (mg/100 g)	08.90
Total sugar (%)	16.07		

Table 2. Formulation of the experimental sapota jam

Sample	TSS (%)	Pulp (% of the standard formula)	pH
A_1	67	100	3.35
A_2	67	75	3.09
A_3	67	50	2.86

3.2. Formulation of different products:
Three different products such as A_1 (100% pulp), A_2 (75% pulp), and A_3 (50% pulp) and their pH were different for these product (Table 2).

3.3. Composition of sapota products
Ascorbic acid (Vitamin C) content in sapota pulp was found to be very low compared to the other fruits. It was further reduced in jams prepared from sapota pulp because most of the ascorbic acid present in the pulp was destroyed during prolonged heating at high temperature. The composition was found to vary with variety, environment and different maturity stages. The average results for the composition of processed sapota jam are presented in Table 3.

3.4. Storage studies of sapota products
Processed sapota jam was stored at ambient temperature (27 ^{0}C to 34 ^{0}C) for a period of 4 months and quality parameters were assessed. During storage, the changes in TSS, acidity, pH, color, flavor, texture, vitamin C and visual fungal growth as observed in the processed sapota jam stored at an ambient temperature for a period of 4 months are presented in Table 4. All parameters of the products were acceptable upto the third month whereas at the fourth month of storage, the quality of the product was deteriorated like as off flavour produced and also acidity increased and pH decreased for all the products. It revealed that the self-life of these products is not more than three months. The results of this study has good agreement with findings of many authors like as Parsi Ros (1976) who stated that jams stored for 180 days at 29.4 ^{0}C were found to be microbiologically safe and to have undergone negligible changes in Brix, pH, color and organoleptic properties.

3.5. Sensory evaluation
The three samples of sapota jam were subjected to sensory evaluation by a Panel of 10 judges evaluated with respect to color, flavor, texture and overall acceptability the results are presented in Table 5.

Table 3. Composition of sapota products (Average of 3 Formulations)

Product	Moisture (%)	Ash (%)	Acidity (%)	pH	Total sugar (%)	Vitamin C (mg/100 g)	TSS (%)
Jam	28.57	0.42	1.05	3.1	61.64	3.36	67

Table 4. Physical and chemical changes occurred in sapota jam with storage time

Storage period (month)	Sample code	Observations			TSS (%)	Acidity (%)	pH	Remarks
		Color	Flavor	Turbidity				
0	A_1	Brown	Fresh	Opaque	67.00	1.07	2.86	Good
	A_2	Brown	Fresh	Opaque	67.00	1.05	3.09	Good
	A_3	Light Brown	Fresh	Opaque	67.00	1.03	3.35	Good
1	A_1	Brown	Fresh	Opaque	67.00	1.12	2.75	Good
	A_2	Brown	Fresh	Opaque	67.00	1.09	3.03	Good
	A_3	Light Brown	Fresh	Opaque	67.00	1.06	3.31	Good
2	A_1	Brown	Fresh	Opaque	67.00	1.20	2.64	Fair
	A_2	Brown	Fresh	Opaque	67.00	1.14	2.95	Good
	A_3	Light Brown	Fresh	Opaque	67.00	1.10	3.24	Good
3	A_1	Brown	Good	Opaque	67.00	1.29	2.51	Fair
	A_2	Brown	Good	Opaque	67.00	1.21	2.84	Fair
	A_3	Light Brown	Good	Opaque	67.00	1.16	3.15	Good
4	A_1	Brown	Off flavor	Opaque	67.00	1.38	2.36	Not good
	A_2	Brown	Off flavor	Opaque	67.00	1.29	2.71	Not good
	A_3	Light Brown	Off flavor	Opaque	67.00	1.24	3.05	Fair

Two way analysis of variance carried out for color preferences revealed that there was significant ($P \leq 0.05$) difference in color acceptability. A_2 was the most preferred one followed by A_1 and A_3 in respect to color preferences. A_2 secured the highest score of 8.2 out of 9 (Table 5).

Significant ($P \leq 0.05$) difference in flavor acceptability was also found. A_2 was the most preferred one followed by A_1 and A_3 in respect to flavor preferences. It can also be noted that A_2 secured the highest score of 7.8 out of 9 (Table 5).

In case of texture preference among the samples a two way analysis of variance indicated that there was significant ($P \leq 0.05$) difference in texture acceptability. The results presented in Table 5 revealed that A_2 was the most preferred one followed by A_1 and A_3 in respect to texture preferences. It can also be noted that A_2 secured the highest score of 7.5 out of 9.

A significant ($P \leq 0.05$) difference in overall acceptability of the three tested experimental jams A_2 was the most preferred one followed by A_1 and A_3. It can also be noted that A_2 secured the highest score of 7.5 out of 9 (Table 5).

The above result shows that the higher the concentration ($\simeq$ 100% pulp) of pulp gives moderate acceptance whereas Jam produced from $2/3^{rd}$ concentration of pulp has excellent acceptance to the panelists. Sandhu *et al.* (1985) investigated the physico-chemical change during preparation of fruit juice concentrate. It was found that deteriorate changes in quality i.e. inversion of sugars, losses of ascorbic acid and browning were more pronounced at higher concentrates of fruit juice.

Table 5. Duncan's Multiple Range Test (DMRT) for color, flavor, texture and overall acceptability of sapota jam

Parameters	Product type	Original order of mean	Product type	Ranked order of mean	LSD value	P (at alpha)	Error mean Square	Error Degrees of Freedom	No. of judges
Color	A_1	7.7^{ab}	A_2	8.2^{a}	0.6239	0.05	0.4410	18	10
	A_2	8.2^{a}	A_1	7.7^{ab}					
	A_3	7.3^{b}	A_3	7.3^{b}					
Flavor	A_1	7.3^{ab}	A_2	7.8^{a}	0.6393	0.05	0.4630	18	10
	A_2	7.8^{a}	A_1	7.3^{ab}					
	A_3	6.8^{b}	A_3	6.8^{b}					
Texture	A_1	6.8^{ab}	A_2	7.5^{a}	0.7254	0.5	0.5960	18	10
	A_2	7.5^{a}	A_1	6.8^{ab}					
	A_3	6.5^{b}	A_3	6.5^{b}					
Overall acceptability	A_1	7.2^{ab}	A_2	7.5^{a}	0.6690	0.05	0.5070	18	10
	A_2	7.5^{a}	A_1	7.2^{ab}					
	A_3	6.6^{b}	A_3	6.6^{b}					

4. Conclusions

In Bangladesh, sapota is produced indigenously and no special care is taken for this fruit. The present study indicates that a good quality value added product could be produced from sapota. As the fruit has some special religious, medicinal, social and nutritive value, it is assumed that it could fetch a good monetary value from the consumers. Though detail price analysis was not done, it is assumed that sapota products might be comparatively inexpensive, as fruit is abundantly available at cheaper prices. The further study indicates that there is a bright prospect of processing of sapota products of commercial value. Further investigation is necessary to study the shelf-life and economic aspects of the products before recommending for commercial production.

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