

Processing and quality evaluation of coconut based jam

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Abstract : Coconut stand out as the foremost amongst the palms that human kind has discovered for its multifarious uses to sustain and support life. In recent years emphasis is focused on product diversification, by products utilization and development of value added coconut products to improve the coconut economy. Coconut jam is a traditional high sugar coconut food product, commonly consumed as desert, bread spread and rice cake topping. An attempt was made to utilize the residual coconut pulp left in the tender coconuts after removal of coconut water. The coconut pulp was mixed with pineapple pulp and guava pulp in different proportions to increase the acceptability of the jam. The prepared coconut jam packed in plastic container and glass bottles and had the shelf life of 180 days at room and refrigerated temperatures. The changes in chemical, microbial and organoleptic characteristics of the coconut jam were studied.

Keywords: Tender coconut, Pineapple, Jam, Glass bottles, plastic containers, Storage

I. Introduction

Coconut palm (*Cocos nucifera* L) a member of the palmae family, is one of the economically important trees in the world. The tree of coconut is called as Kalpatara, because all the parts of it are useful in one form or the other. Coconuts and coconut oil have been eaten as a primary food for thousands of years by millions of people in Asia, the Pacific islands, Africa and Central America. Several traditional foods containing coconut products are being prepared and processed using newer processing techniques and tested for their acceptability, quality and commercial viability (Kumar et al., 2007 [1]). As a functional food, coconut has fatty acids that provide both energy and raw material for antimicrobial activity and monoglycerides. Lauric acid, the major fatty acid present in coconut, has been recognized for its antiviral, antibacterial and antiprotozoal functions. Young tender coconuts are widely consumed as fruit which consists of a soft white flesh and sweet aromatic juice. Initially, the young coconut kernel contains more water. The flesh of the young coconut is an aluminous endosperm which is white in colour, edible, soft and more jelly like. It is sweet to taste and is relatively high in minerals such as iron, phosphorus and zinc. The residual pulp left after removal of water from the kernels can be converted in to value added products such as jam.

Jam is a traditional high sugar coconut food product, commonly consumed as desert, bread spread, and rice cake topping. It is as intermediate moisture food prepared by boiling fruit pulp pulp with sugar, pectin, acid and other ingredients (preservatives, coloring and flavouring materials). It is light to dark brown in color, thick get spreadable in consistency, with a rich creamy flavor. Jams can be prepared from single fruit or in combination with two or more fruits. Tender coconuts are generally cut and the inside water is consumed as such as a drink or used for the development of beverages. However, the food use of residual young coconut kernel has not been explored much. Therefore, the present study was undertaken to utilize residual tender coconut pulp for the development of jam product in combination with pine apple pulp and guava pulp with an objective of increased palatability and sensory acceptability.

II. Materials and Methods

2.1 Raw materials

Tender green coconuts and sound ripe pineapple and guava fruits were procured from the local market of Madurai city, India. Green coconuts of around 8-9 months old and characterized by sweet juice with a moderately thick pulp were selected for the present study. A sanitized stainless steel knife was used to cut a small incision at the top of the nuts for the extraction of coconut water as well as to scope out the pulp. Pineapples were washed and peeled and the crowns as well as eyes were removed followed by pulping using a mixer. Fresh and riped guavas were cleaned, cutting into pieces and make into fine pulp using mixie.

2.2 Preparation of Jam

For the standardization of jam, Pectin rich fruits such as pineapple, guava were incorporated along with tender coconut pulp in different ratios as given in Table 1

Table 1. Development of Coconut based Jam

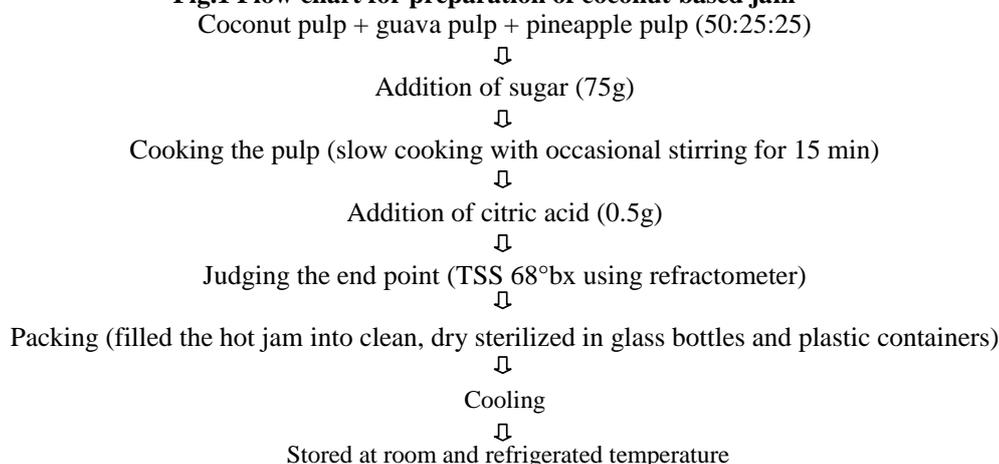
Ingredients	Level of incorporation (g)					
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆
Tender coconut pulp	100	90	80	70	60	50
Pineapple pulp	-	5	10	15	20	25
Guava pulp	-	5	10	15	20	25
sugar	75	75	75	75	75	75
Citric acid	0.5	0.5	0.5	0.5	0.5	0.5

The prepared jam was evaluated organoleptically and found that jam prepared from 50 per cent tender coconut pulp 25 per cent pine apple pulp and 25 per cent guava pulp was highly acceptable.

2.3 Method of preparation

The mixture of tender coconut pulp, pineapple pulp and guava pulp in standardized proportion was taken in an open stainless steel pan and a required amount of sugar was added and heated continuously on a gas stove under low flame. When the total soluble solids (TSS) reached 60°bx, citric acid was added and the pulp mixture was mixed thoroughly and stirred continuously using a steel ladle. Heating was stopped when the TSS reached 67- 68°bx, and the mixture was hot filled into 300 ml previously sterilized glass bottles and plastic container and cooled under ambient conditions. The jam prepared was stored at ambient and refrigerated temperatures and away from light and analyzed over a period 6 months.

Fig.1 Flow chart for preparation of coconut based jam



2.4 Physicochemical characteristics of Jam

Knowledge of the physico-chemical properties of food is fundamental in analyzing the characteristics of food during its processing. The study of these food properties and their responses to process conditions are necessary because they influence the treatment received during the processing and qualities of food (Rao and Das, 2003 [2]). Total soluble solids were measured using a hand refractometer (ERMA, Tokyo, Japan) and expressed as degree Brix. The pH of samples was measured using microprocessor based digital pH meter (Century Model CP931, Bangalore, India). The acidity of the sample was estimated by the (Ranganna, 1995[3]) the total and reducing sugar content of the sample was determined by the Shaffer Somogyi micro method described by McDonald and Foley (1960[4]). Ascorbic acid was estimated following the procedure of Mahadevan and Sridhar (1982 [5]). The ash contents of the jam were determined according to the AOAC methods (1970[6]). The minerals like calcium and phosphorus were determined using an atomic absorption spectrometer (AAS Varian 6, Analytik jena AG, Germany) at a wavelength of 442.7, 248.3 nm respectively.

2.5 Organoleptic evaluation

Sensory evaluation offers the opportunity to obtain a complete analysis of the various properties of food as perceived by human sense. Sensory evaluation is an important and best method for evaluating new products developed which provide quality measure and production control. The sensory evaluation of the jam was done using a nine point hedonic scale. A panel of 20 semi trained members evaluated the prepared coconut based jam packed in glass bottles and plastic containers stored at room and refrigerated temperatures at an interval of 30 days for a period of 180 days.

2.6 Determination of microbial load

The microbial load of the stored samples were enumerated initially and at the end of the storage period by the method described by Istavankiss (1984 [7]).

2.7 Statistical analysis

The data obtained were subjected to statistical analysis to find out the impact of storage period, different packaging materials, and temperatures on the quality of the products during storage. Three factorial completely randomized designs were applied for the analysis (Gomez and Gomez, 1984 [8]).

III. Results and Discussion

3.1 Physicochemical characteristics of tender coconut based jam

The results pertaining to physicochemical characteristics of the tender coconut based jam samples are shown in Table 1. The samples were evaluated once in 30 days.

3.1.1 pH

Fruit products are being effectively preserved at low pH. The initial pH of coconut based jam was 2.86 in all the packaging material. An increase in refrigerated samples of coconut based jam showed lowering in the pH during storage compared to room temperature in all the packaging materials.

3.1.2 Acidity (%)

The initial acidity of coconut based jam was 0.53 per cent in glass bottles and plastic container under room and refrigerated temperature. A gradual increase in acidity of samples packed in various packaging materials were observed during storage. Kalarani and amutha (2000 [9]) reported that there was a gradual increase in the acidity and a reduction in pH of custard apple jam packed in the various packaging materials.

3.1.3 Total soluble solids

TSS of the products was the index of sweetness. The initial TSS content of coconut based jam was 68.50°brix which was increased to 72.00 and 73.00°bx when packed in glass bottles and plastic container stored at room temperature and also increased to 70.00 and 71.00°bx stored at refrigeration temperature. Koli *et al* (2004 [10]) showed that the gradual increase in total soluble solids from 69.32 to 70.31°bx observed in sapota jam during storage period.

3.1.4 Reducing sugar (g/100g)

Reducing sugar of coconut based jam was increased gradually during storage. The increase in reducing sugar content of the sample stored at refrigeration temperature was slightly lesser than the sample stored at room temperature. In the samples stored at room and refrigerated temperature the reducing sugar content changed from 15.00 to 15.75, 15.79, 15.45 and 15.52g/100g respectively. Similar observation was found by Aruna *et al* (1998 [11]) where there was an increase in reducing sugar content of sapota jam from 38.60 to 43.73 per cent at the end of the storage period.

3.1.5 Total sugar (g/100g)

The breakdown of total sugar into simple sugar would have decreased the quantum of total sugar. The initial total sugar coconut based jam were 52.20 g/100g which was decreased to 51.60, 51.65, 51.28, 51.32g/100g in the packaging materials glass bottles and plastic container stored at room and refrigeration temperature respectively. In the present investigation the actual decrease in the total sugar content was more in room temperature stored the sample than in refrigeration stored samples.

3.1.6 Vitamin C (mg/100g)

The ascorbic acid content decreased during storage due to oxidation of ascorbic acid to dehydroascorbic acid. Hence vitamin C estimation was carried out during the storage period. This is due to oxidation or exposure to atmosphere oxygen while preparing the jam (Fennema, 1977 [12]).

Coconut based jam had 38.20 mg/100g initially. The loss of the vitamin C content of coconut based jam stored in room and refrigeration temperature were from 38.20 to 35.50 mg/100g in all the packaging materials. Temperature has a major effect on the rate of loss of ascorbic acid. Losses of ascorbic acid were increased with the increase in temperature (Johnson and Hessel, 1982 [13]). This was observed by Vidhya and Narain, (2010[14]) in the storage of wood apple jam. The loss of vitamin C in the initial stages of preservation is because of the presence of oxygen in the headspace (Reimer and Karel, 1978[15]).

3.1.7 Calcium (mg/100g)

Mineral analysis showed that minimum decrease was observed during storage. The initial calcium content was of coconut based jam was 15.20 mg/100g which was decreased to 15.08 mg/100g and 15.04 mg/100g when packed in glass bottles and plastic container at room temperature and also decreased to 15.10 mg/100g and 15.02 mg/100g stored at refrigeration temperature.

3.1.8 Phosphorous (mg/100g)

Coconut based jam had an initial phosphorous content of 25.16 mg/100g in room and refrigeration temperature. A slight reduction of phosphorous content in coconut based jam was observed during storage.

Vidhya and Narain (2010) reported wood apple jam calcium and phosphorous content was decreased in wood apple jam during storage. Similar trend was noted in the present study

Table 2. Changes of nutrient content in tender coconut based jam during storage

Nutrients	Room Temperature						Refrigerated Temperature						SED	CD 0.05
	Glass bottle			Plastic container			Glass bottle			Plastic container				
	0 day	90 th day	180 th day	0 day	90 th day	180 th day	0 day	90 th day	180 th day	0 day	90 th day	180 th day		
pH	2.86	2.73	2.68	2.86	2.70	2.65	2.86	2.80	2.75	2.86	2.78	2.72	0.00707	0.01541**
Acidity (%)	0.53	0.67	0.78	0.53	0.69	0.80	0.53	0.65	0.70	0.53	0.62	0.75	0.01225	0.02669**
TSS (°brix)	68.50	70.00	72.00	68.50	71.00	73.00	68.50	69.00	70.00	68.50	69.00	71.00	0.01399	0.04275**
Reducing sugar (g/100g)	15.00	15.60	15.75	15.00	15.63	15.79	15.00	15.32	15.45	15.00	15.40	15.52	0.03884	0.08462**
Total sugar (g/100g)	52.20	51.43	51.60	52.20	51.50	51.65	52.20	51.95	51.28	52.20	51.90	51.32	0.01354	0.02950**
Vitamin C (mg/100g)	38.20	37.80	35.64	38.20	37.65	35.50	38.20	38.10	38.02	38.20	38.08	38.00	0.01275	0.02777**
Calcium mg/100g)	15.20	15.14	15.08	15.20	15.12	15.04	15.20	15.18	15.10	15.20	15.08	15.02	0.01732	0.03774**
Phosphorus (mg/100g)	25.16	25.10	25.02	25.16	25.08	25.00	25.16	25.12	25.16	25.16	25.11	25.05	0.01061	0.02311**

3.2 Microbial load of the prepared coconut based jam

The microbial load of coconut based jam was enumerated and is given in Table 2.

Table 2. Enumeration of microbial load in coconut based jam during storage

Particulars	Room temperature				Refrigerated temperature			
	Glass bottle		Plastic container		Glass bottle		Plastic container	
	0 day	180 th day	0 day	180 th day	0 day	180 th day	0 day	180 th day
Bacteria (x10 ⁻⁶ cfu/g)	2.00	7.00	2.00	8.00	2.00	5.00	2.00	6.00
Fungi (x10 ⁻² cfu/g)	1.00	6.00	1.00	7.00	1.00	4.00	1.00	5.00

The initial bacterial and fungal population of the coconut based jam was 2.00 x 10⁻⁶cfu/g and 1.00x 10⁻⁶cfu/g respectively. An increasing trend in bacterial and fungal population was observed in the stored coconut based jam throughout the storage period. A minimum count was recorded in the samples packed in glass bottles. The jam packed in plastic containers exhibited a slightly higher microbial load than the jam packed in glass bottles. There was acceptable amount of microbes has observed at the end of the storage period. Vidhya and Narain (2010) have observed the microbial load of wood apple jam was under the limit at the end of the storage period. Similar condition was observed in coconut based jam.

3.3 Organoleptic evaluation of coconut based jam

The mean scores of colour and appearance, flavor, consistency, taste and overall acceptability are given in Table 3.

The mean score for all the quality attributes was initially 9.00 for all the packaging materials. Slight changes were observed in all the packaging materials after 180 days storage. Though there was high sensory scores was observed in refrigerated coconut based jam during storage. Chauhan *et al* (2012[16]) observed that the jam prepared from tender coconut pulp and pine apple pulp showed a good sensory acceptability after 6 months of storage at room and refrigerated conditions.

Table 3. Organoleptic characteristics of coconut based jam during storage.

Particulars	Room temperature				Refrigerated temperature			
	Glass bottle		Plastic container		Glass bottle		Plastic container	
	0 day	180 th day	0 day	180 th day	0 day	180 th day	0 day	180 th day
Colour and appearance	9.0	8.6	9.0	8.6	9.0	8.7	9.0	8.6
Flavour	9.0	8.5	9.0	8.5	9.0	8.6	9.0	8.5
Consistency	9.0	8.4	9.0	8.4	9.0	8.7	9.0	8.6
Taste	9.0	8.3	9.0	8.2	9.0	8.6	9.0	8.5
Overall acceptability	9.0	8.5	9.0	8.5	9.0	8.7	9.0	8.6

IV. Conclusion

In recent years, emphasis is focused on product diversification, by products utilization and development of value added coconut products to improve the coconut economy. Hence, the jam prepared at optimum conditions of tender coconut pulp, pineapple pulp and guava pulp showed a good sensory acceptability after 6 months of storage in glass bottles and plastic containers at room and refrigerated conditions on the basis of physicochemical and sensory attributes. A great advantage in its preparation is that it can be prepared in a single operation. In addition to the pleasing taste of coconut based jam, they possess highly nutritive value, safe and fit for consumption.

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