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Research article

STUDIES ON PRESERVATION AND PROCESSING OF CUSTARD APPLE (Annona squamosa L.) PULP

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ABSTRACT: Custard apple is one of the important fruit crops of Andhra Pradesh, which ripen within four days after harvest. Considering the fast increasing area under custard apple cultivation, methods of its preservation and processing technology needs to be developed to regulate the prices of produce during glut period. Pulp was extracted from custard apples and stored for a period of six months by addition of 1500ppm of potassium metabisulphite. After six months, various products like squash and nectar were prepared. The products were stored at room temperature and cold storage for a period of four months to study the stability and consumer acceptability of the products. The products were analysed every month for physico-chemical qualities. The pH, acidity, ascorbic acid and sulphurdioxide were lower in all the products compared to the stored pulp. All the products stored at cold storage were good physic-chemically when compared to the products stored at room temperature.
Key words: Custard apple, Squash, Nectar and Pulp

INTRODUCTION

Custard apple is one of the important fruit crops of Andhra Pradesh. Nearly 75000 tones of this fruit is available from the state [1, 2]. Custard apple is a hardy crop, which can be grown on marginal lands with minimum inputs. Custard apple, popularly known as Sitaphal is grown in about 40000 ha in India mainly in the states of Andhra Pradesh, Assam, Tamilnadu and grows wild in Deccan plateau and some parts of central India [3]. Custard apple is considered as one of the delicious and nutritionally valuable fruit meant for table purpose [4]. Fruits have an edible, soft, granular, juicy and sugary pulp with mild flavor and with slight acidity [5]. Fruits are considered for their medicinal value besides their general use in ice cream, confectionery and certain milk products [6]. Custard apple is considered as one of the delicious and nutritionally valuable fruit. It contains about 28-55% of edible portion consisting of 73.30% moisture, 1.60% protein, 0.30% fat, 0.70% mineral matter, 23.90% carbohydrates, 0.20% calcium, 0.40% phosphorus, 1.0% iron, 12.4-18.15% sugar, 0.26-0.65% acidity and with caloric value of 105K.Cal/100g [7]. Custard apple is generally classified as semi wild fruit by virtue of its spontaneous spread in forests, wastelands and other uncultivated places [8]. Custard apple ripens within four days after harvest. Fruits can safely be ripened in straw and fruit leaves and stored at room temperature with a shelf life of four days [9, 10]. The ripe fruits being soft require careful handling in marketing [11]. Like many other tropical fruits, the mature custard apple fruits get chilling injury if stored below 15^{o}c, while ripe fruits can be stored at 5^{o}c, for six weeks [12]. In this work we have studied on storage of the custard apple pulp and preparation, evaluation of products from custard apple pulp.

MATERIALS AND METHODS

Custard apples (Annona squamosa) fruits were procured in bulk from the local market. Chemicals used in experimentation and analysis were of analytical grade, purchased from standard Indian companies. Media and chemicals used for microbial analysis were also from standard companies.

Extraction of pulp:

Fully ripened fruits were selected and the pulp was extracted manually under hygienic conditions. The seeds and pulp were separated from each other by rubbing the mixture on a 30 mesh sieve leaving the seeds and the covering sheath of the capillary pulp [13, 14].

PREPARATION OF THE PRODUCTS

After 6 months of storage, the stored pulp was analyzed both chemically and microbiologically before preparing the products and utilized for products preparations [14, 15]. The various products prepared from custard apple pulp are:

Squash

Sugar syrup was prepared to which citric acid was added. The syrup was cooled and homogenized pulp was added and mixed thoroughly. Potassium meta bisulphate was added as preservative, filled in bottles and capped. Squash needs to be diluted before serving [16].

Nectar

Homogenized pulp was mixed with sugar solution of 15^0C brix to which citric acid was added. The solution was filled in sterilized bottles till it overflows to remove air and foam. They are then crown corked and pasteurized at 90^oC for 25 minutes, cooled and stored [17].

SHELF LIFE STUDY OF THE PRODUCTS:

The prepared products were stored both at room temperature and cold storage (5-10^oC) to study the shelf life of the products. The products are initially analyzed chemically, microbiologically and organoleptically before storage [18, 19].

Observations recorded:

Custard apple attains a bitter taste upon exposure to heat, but it is interesting to note that there was no such bitterness observed in any of the products prepared even though all the products prepared involved heat processing. The products were analyzed at an interval of every 30 days for the following parameters and recorded.

Physico – chemical analysis of the products:

pH:

The pH of the products was determined by using a pH meter.

Total soluble solids (^{O} brix):

The percentage of total soluble solids were determined by using "Erma" hand refractometer and expressed as percent total soluble solids (^{O} brix) (Ranganna, 1986).

Acidity:

The acidity of the samples was determined by diluting an aliquot of the sample with distilled water and titrating with 0.1N NaoH using phenolphthalein as indicator. The calculated acidity was expressed as percent anhydrous citric acid.

Sugars (%):

Reducing sugars and total sugars were determined by the method of "Lane and Eynon" (1923).

Reducing Sugars:

To 25g of the sample in a volumetric flask 100ml of water was added and neutralized with 1N NaoH. 2ml of 66% lead acetate solution was added and kept for 10 minutes. Excess lead acetate was precipitated by necessary amount of 20% potassium oxalate, made upto the volume with water, filtered and taken in burette. 10ml of mixed Fehling's solution was taken in 250ml conical flask. Little quantity of the sample was run into flask and heated to boil moderately for 2 minutes. 3 drops of methylene blue solution was added and completed the titration until the indicator was completely decolourized. Brick red colour of the solution indicates the end point.

Total sugars:

For total sugars 50 ml of filtered sample was taken in a 250 ml conical flask to which 50 ml water and 5g of citric acid was added, boiled gently for 10 minutes to complete the inversion of sucrose, transfered to 250 ml volumetric flask and neutralized with 1N NaoH. The volume was made upto the mark and determined the total sugars as invert sugars.

Ascorbic acid (mg/100ml or 100g sample):

Ascorbic acid was estimated by visual titration method (Ranganna, 1986). 10ml of the sample was made upto 100 ml with 3% metaphosphoric acid and filtered. To estimate the interference of sulphur dioxide in the sample, 10ml of the filtrate was taken and added with 1 ml of 40% formaldehyde and 0.1 ml of HCl and kept for 10 minutes. The sample was titrated with the standard 2.6-dichlorophenol-indophenol dye to a pink end-point that should persist for atleast 15 seconds.

Sulphur dioxide

Sulphur dioxide in the sample was calculated by modified "Ripper titration" method (Ranganna, 1986).To two similar aliquots of the sample 5ml of 5N NaoH was added and allowed to stand for 20 minutes. To one of the samples 7ml of 5N HCl was added and titrated immediately with 0.02 N iodine to a definite dark blue colour with 1% starch solution as indicator (a). To determine the reducing substances other than sulphite, the second sample was also acidified with 7 ml of 5N HCl and 10 ml of 36-40% formaldehyde was added and kept for 10 minutes. The sample was titrated until a dark blue colour persists for atleast 15 seconds (b). Volume of iodine used by the total sulphur dioxide present in the sample is equal to (a-b) ml.

Data Presentation

All the details pertaining to physico-chemical changes in the processed products like acidity, reducing and total sugars were presented per 100g of the product. Thus all the values were represented as percentage. Sulphur dioxide was represented as ppm and ascorbic acid as mg/100g of the sample. The sensory qualities of each parameter were expressed for 5 points since the highest rank was 5. Microbiological qualities in the products were presented for1 ml.

Statistical Analysis

In order to understand the significant changes on storage, analysis of variance (ANOVA) and CRD test was carried out for sensory parameters like colour, appearance, flavour, taste and overall acceptability for each product (Panse and Sukhatne, 1985). Similar analysis was done to understand the significant changes in the physico-chemical characteristics such as pH, total soluble solids, acidity, ascorbic acid, sulphur dioxide, reducing and total sugars [20].

RESULTS AND DISCUSSION

Custard apple products like squash and nectar, were prepared from preserved custard apple pulp and stored at room temperature and cold storage for a period of 4 months to study the stability of the products. The products were analysed every month for physico-chemical qualities.

Physico-chemical characteristics of custard apple pulp and its products

pH

The pH of all products prepared from the stored pulp was lower compared to the pulp. The pH of the stored pulp was 5.62. The initial pH of the products prepared were squash 4.26 and nectar 3.74. The decrease in pH of the products may be attributed to the added citric acid. Decrease in pH of nectar due to added citric acid was reported by Teotia et al. (1997) and Aruna et al. (1997) in case of papaya.

Total soluble solids (TSS)

The TSS of the stored pulp was 28^{o}C. Initial TSS reading of the squash was found to be higher (51□), which is due to added sugars in squash that increased the TSS value. The lower TSS value in nectar (14□) is due to the dilution of the products. However, TSS of the products were in accordance with the FPO specifications.

Acidity

Acidity was found to be lower in all the products prepared compared to the stored pulp. This may be due to the dilution of the products during processed. The acidity of the pulp preserved was 0.51%. The acidity of the products were squash 0.32% and nectar 0.44%.

Ascorbic acid

Ascorbic acid content was found to be lower in all the products prepared compared to the stored pulp. The reduction in ascorbic acid may be attributed to its destruction by oxidation or heat during processing.

Sulphurdioxide

Custard apple pulp was stored by the addition of 1500 ppm of potassium metabisulphite. The SO_2 content of the pulp after a storage period of 6 months was found to be 884 ppm which was within the FPO specifications. SO_2 Content of the products prepared from the stored pulp were lower compared to the pulp and varied depending upon the product. The decrease in the SO_2 content may be attributed to the dilution of the products with water or due to varying levels of pulp used during preparation of the products or due to its destruction by heat. The initial SO_2 content of squash was 376 ppm and nectar 160 ppm which were higher than the FPO specification which allows 350 ppm and 100 ppm of SO_2 in squash and nectar respectively. Hence, it can be expected that the marginally higher levels of SO_2 in squash and nectar will be reduced to conform to the FPO specification.

Total sugars and Reducing sugars

The total sugar content of the store pulp was 21.42%. The total sugar content of the products prepared were higher than that of the stored pulp. The high sugar content is due to the added sugar. The initial reducing sugar content of the pulp was 20.75% which increased in all the products.

Table–1: Physico–chemical characteristics of custard apple pulp and its products before storage.

Parameters	Pulp	Squash	Nectar
pH	5.62	4.26	3.74
TSS(° B)	28°	51°	14°
Acidity %	0.51	0.32	0.44
Ascorbic acid (mg/100ml or 100 g)	9.22	6.96	2.32
Sulphurdioxide (ppm)	883.97	376	160
Reducing sugars (%)	20.75	42.83	20.5
Total sugars (%)	21.42	57.53	23.62

Storage studies of processed custard apple products

The products squash and nectar prepared from the stored pulp were stored both at cold storage and room temperature for a period of 4 months to determine their keeping quality and acceptability. The products were analysed every month for physico-chemical and bimonthly for microbiological characteristics to evaluate their stability.

pH

Slight decline in pH of the all the products was observed during 4 months of storage. Decrease in pH of the products is due to the added citric acid during processing.

Table 2: pH of processed custard apple products.

	C_1				C_2			
	Pe_1	Pe_2	Pe_3	Pe_4	Pe_1	Pe_2	Pe_3	Pe_4
P_1	4.20	3.98	3.98	3.83	4.24	4.12	3.95	3.88
P_2	3.70	3.54	3.40	3.42	3.70	3.62	3.52	3.49
S.E ±	0.05							
CD (P = 0.05)	NS							

NS = Non significant, C_1 = Room temperature, C_2 = Cold storage, P_1 = Squash, P_2 = Nectar, Pe_1 = 1st month of storage, Pe_2 = 2nd month of storage, Pe_3 = 3rd month of storage, Pe_4 = 4th month of storage

Total soluble solids (TSS)

The TSS of the products stored for 4 months showed varying results. There was a slight increase in TSS in squash 51° to 52.9° after 4 months of storage. TSS of squash stored at cold storage was higher than that at room temperature. The TSS of nectar decreased from (14° to 12°) upon storage. Decrease in TSS is may be due to settling down of some soluble colloidal solids, incipient fermentation and other chemical reactions of sugar in presence of acid during storage.

Table 3: TSS of Processed custard apple products

	C_1				C_2			
	Pe_1	Pe_2	Pe_3	Pe_4	Pe_1	Pe_2	Pe_3	Pe_4
P_1	51.00	51.16	51.33	52.00	52.00	52.16	52.66	53.83
P_2	14.00	14.16	13.16	12.00	14.00	14.16	13.33	12.16
S.E ±	0.13							
CD (P = 0.05)	NS							

NS = Non significant, C_1 = Room temperature, C_2 = Cold storage, P_1 = Squash, P_2 = Nectar, Pe_1 = 1st month of storage, Pe_2 = 2nd month of storage, Pe_3 = 3rd month of storage, Pe_4 = 4th month of storage

Acidity

In squash and nectar the acidity was found to be decreasing with increase in storage periods inspite of a slight decline in pH, the reason for which is unknown.

Table-4: Acidity of custard apple products (%)

	C_1				C_2			
	Pe_1	**Pe_2**	**Pe_3**	**Pe_4**	**Pe_1**	**Pe_2**	**Pe_3**	**Pe_4**
P_1	0.24	0.38	0.19	0.12	0.32	0.57	0.12	0.12
P_2	0.12	0.83	0.32	0.19	0.38	1.02	0.38	0.19
S.E ±	0.0118							
CD (P = 0.05)	0.0332							

NS = Non significant, C_1 = Room temperature, C_2 = Cold storage, P_1 = Squash, P_2 = Nectar, Pe_1 = 1st month of storage, Pe_2 = 2nd month of storage, Pe_3 = 3rd month of storage, Pe_4 = 4th month of storage

Ascorbic acid

Ascorbic acid showed a continuous decrease in all the products as the storage period advanced except for slight increase in nectar. The loss varied between 6.96 to 4.08 mg/100 ml juice in squash. Decreasing levels of ascorbic acid may be due to its gradual oxidation upon storage.

Table 5: Ascorbic acid of custard apple products (mg/100mg or 100g sample)

	C_1				C_2			
	Pe_1	**Pe_2**	**Pe_3**	**Pe_4**	**Pe_1**	**Pe_2**	**Pe_3**	**Pe_4**
P_1	1.56	5.80	4.64	3.48	4.44	3.48	3.48	5.80
P_2	1.11	3.48	2.90	2.32	3.33	2.90	2.90	3.48
S.E ±	0.1849							
CD (P = 0.05)	0.5218							

NS = Non significant, C_1 = Room temperature, C_2 = Cold storage, P_1 = Squash, P_2 = Nectar, Pe_1 = 1st month of storage, Pe_2 = 2nd month of storage, Pe_3 = 3rd month of storage, Pe_4 = 4th month of storage

Sulphurdioxide

There was a gradual decrease in SO_2 content of all the products upon storage. The loss varied between 376 ppm to 234 ppm in squash, 160 to 99 ppm in nectar. Loss of SO_2 was more in products stored at room temperature compared to that at cold storage. The SO_2 content of all the products stored at room temperature and cold storage were below the FAO standards except for a slight higher SO_2 content in nectar stored at cold storage (109 ppm).

Table-6: Sulphur dioxide of custard apple products (ppm)

	C_1				C_2			
	Pe_1	**Pe_2**	**Pe_3**	**Pe_4**	**Pe_1**	**Pe_2**	**Pe_3**	**Pe_4**
P_1	110.81	160.00	160.20	160.00	371.20	329.60	294.40	288.00
P_2	102.40	96.00	89.60	67.20	147.20	112.00	102.40	76.80
S.E ±	10.1205							
CD (P = 0.05)	28.5649							

NS = Non significant, C_1 = Room temperature, C_2 = Cold storage, P_1 = Squash, P_2 = Nectar, Pe_1 = 1st month of storage, Pe_2 = 2nd month of storage, Pe_3 = 3rd month of storage, Pe_4 = 4th month of storage

Reducing sugars

A decrease in reducing sugar content was observed in squash upon storage. Decrease in reducing sugars is because inversion might not have occurred in the products.

Table-7: Reducing sugars of custard apple products

	C_1				C_2			
	Pe_1	**Pe_2**	**Pe_3**	**Pe_4**	**Pe_1**	**Pe_2**	**Pe_3**	**Pe_4**
P_1	23.98	33.52	30.44	25.90	38.00	47.50	40.18	34.54
P_2	17.50	7.52	7.05	6.28	16.28	8.76	8.59	19.00
S.E ±	2.22							
CD (P = 0.05)	NS							

NS = Non significant, C_1 = Room temperature, C_2 = Cold storage, P_1 = Squash, P_2 = Nectar, Pe_1 = 1st month of storage, Pe_2 = 2nd month of storage, Pe_3 = 3rd month of storage, Pe_4 = 4th month of storage

CONCLUSION

Pulp was extracted from custard apples during the glut season and stored for a period of 6 months by addition of 1500 ppm of KMS and after 6 months various products were prepared and assessed for their keeping quality at both room temperature and cold storage. It may be possible for the industries to prepare custard apple pulp for a few months during the peak season and subsequently utilize it for products preparation. With that assumption, custard apple pulp was stored for approximately 6 months before using it for product preparation. The products were further stored for 4 months to determine their keeping quality and acceptability. Physico-chemical evaluation of the stored pulp and the products prepared from the stored pulp during different storage periods indicated that the products could be stored for at least 4 months without deterioration. Cold storage or low temperature storage of the products is preferred but in areas where low temperature facility is not available the product should be stored in dark avoiding direct exposure to heat and sunlight which may lead to undesirable changes in the product.

The custard apple products are novel and could be far cheaper. They could easily find market as custard apple is seasonal fruit. Cost of production could not be compared directly as no such products prepared from custard apple are available in the market at present. Compared to the products processed from other fruits custard apple products are far cheaper and lower cost of production is attributable to the low cost of basic raw material.

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