

Original Research Article

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## Standardization of Recipes of Custard Apple Jam and Analysis of Physico-Chemical Characteristics, Sensory Quality and Storage Behaviour

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### ABSTRACT

#### Keywords

Physico-chemical characteristics, Sensory quality, Storage, Jam, Custard apple, Processing etc.

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The experiment was carried out to assess the physico-chemical characteristics of custard apple fruits, standardization of pulp: water ratio and recipes for jam and to study the sensory qualities changes of jam during storage at ambient temperature. The experiment was done during the year 2016-17 in the Department of Fruit Science, College of Agriculture, IGKV, Raipur (C.G.). Under the present study physico-chemical characteristics of fruit was observed and found that the 50:50 (pulp: water) ratio got highest organoleptic score from different ratio of pulp: water. As per the investigation, results revealed that 50% pulp, 75% TSS and 0.3 % acidity was found most suitable for jam among all recipes. During storage reducing sugar, total sugar and acidity increased, while ascorbic acid and non-reducing sugar decreased continuously in jam. The product was organoleptically acceptable for four months.

### Introduction

It is well recognized that fruits are very important in human diet. The indigenous fruits, which are locally available in a particular season, play a vital role in the nutrition of rural mass. Custard apple is one of the most important seasonal fruit, which is botanically known as *Annona squamosa* L., belongs to family Annonaceae and indigenous to Tropical America. It is also known as sugar apple, sweet sop, sitaphal or sharifa. It is one of the important minor fruit of India.

Custard apple plants have important features of wide adaptability to soil and climatic conditions and freedom from pests and diseases. Due to their hardy nature and escape from animal damage, custard apple has been naturalized in many tropical and subtropical parts of the world along with a tremendous scope for further expansion (Hays, 1957).

In India the custard apple fruits are very popular in the Daccen plateau. In Chhattisgarh it is mostly cultivated on wasteland, rice bunds and most of the forest area of Raipur, Bastar, Kanker and Mahasamund. In India, custard

apple is grown in an area of 29.87 thousand hectare with an annual production of 228.37 million tonnes. Chhattisgarh is one of the States in which custard apple is produced in 7.99 thousand hectares having annual productions of 39,730 metric tonnes (Anon., 2014). However it is not cultivated on commercial scale in Chhattisgarh.

Custard apple contains 70.5 g moisture, 310 (kj) energy, phosphorus 54 mg and fibre 3.1 g (Wenkam, 1990). The food value lies mainly in sugar content that varies from 12.4 to 18.5 per cent. The acidity ranges between 0.26 to 0.65 per cent. The variations are attributed to the differences in growing conditions and sampling (Alexander *et al.*, 1982).

The fruit jam has largely been prepared from common fruits like mango, orange, pineapple, guava and litchi etc. Custard apple can make excellent fruit processed products due to its pleasant flavor. Processing of custard apple into quality produced such as jam would be more nutritious than many of the synthetic products.

Being a highly perishable nature of fruits, it is most difficult to store and transportation. The excellent nutritive and therapeutic attempts are needed to standardize the recipes for preparation of new value added products such as RTS, nectar, squash and jam also. Looking to the above facts this investigation was carried out to store the custard apple as processed product for use even in off season.

## **Materials and Methods**

The experiment was under taken during 2016-17 in the Department of Fruit Science, College of Agriculture, IGKV, Raipur (C.G.). It is situated in the central part of the Chhattisgarh. Well ripened custard apple fruits cv. Local were procured from the local market and the basic materials used in the present

investigation. Randomly selected ten ripened custard apple fruits taken under each replication to assess the physico-chemical composition.

To standardize the method of pulp extraction four different pulp: water ratio *viz.* T<sub>1</sub>: Pulp (25%): Water (75%), T<sub>2</sub>: Pulp (50%): Water (50%), T<sub>3</sub>: Pulp (75%): Water (25%), T<sub>4</sub>: Pulp (100%): Water (0) were used as treatments with 3 replications in CRD.

To evaluate the organoleptic quality of different recipes (Pulp %: TSS %: Acidity %) for jam processing Two Factor Factorial Experiment in Randomized Completely Block Design was used with 9 treatments *viz.* T<sub>1</sub> (Pulp 50%: TSS 70%: Acidity 0.2%), T<sub>2</sub> (Pulp 50%: TSS 70%: Acidity 0.3%), T<sub>3</sub> (Pulp 50%: TSS 70%: Acidity 0.5%), T<sub>4</sub> (Pulp 50%: TSS 75%: Acidity 0.2%), T<sub>5</sub> (Pulp 50%: TSS 75%: Acidity 0.3%), T<sub>6</sub> (Pulp 50%: TSS 75%: Acidity 0.5%), T<sub>7</sub> (Pulp 50%: TSS 80%: Acidity 0.2%), T<sub>8</sub> (Pulp 50%: TSS 80%: Acidity 0.3%) and T<sub>9</sub> (Pulp 50%: TSS 80%: Acidity 0.5%) and 6 replications (6 bottles under each treatment).

To study the shelf life of processed products organoleptic evaluation and chemical analysis was done with 6 treatments (at 0, 30, 60, 90, 120, 150 days after processing) and 3 replications in One Factor Completely Randomized Design.

Firm ripe fruits were selected for the preparation of custard apple jam. The fruit were washed, peeled and extracted pulp with the help of pulper and sieved to obtain a fine fruit pulp devoid of seeds and skin. For formulation of recipe, the total soluble solids and total acidity present in the pulp were first determined and then remaining amount of sugar and citric acid were adjusted. 500 g of jam of each recipe was prepared by mixing the calculated amount of pulp, sugar and citric

acid. Addition of sugar in pulp with necessary amount of water and boiling with continuous stirring then added citric acid and judge the end-point for further cooking, filled hot into sterilized bottles. Waxing is done by paraffin wax to avoid contamination of other organism. The bottles of jam were kept at ambient temperature for further studies upto acceptability.

To analyze the physical composition of fruits, weight (g) of fruits, pulp, peel, seeds, weight and number of seeds per fruit, length and diameter of fruit (cm), width and length of seed (cm), thickness of peel(cm), pulp, seed and peel percentage, pulp: seed ratio, moisture percentage, colour of peel, volume of fruits and seeds (cc) were observed (Table 1).

Under the chemical composition of fruits and jam, Ascorbic acid (mg/100g), Total Soluble Solids (%), Acidity (%), Reducing sugar (%), Non-reducing sugar (%), Total sugar (%) were observed.

The jam prepared from the local cultivar of custard apple were subjected to sensory evaluation by a panel of 9 judges following the hedonic rating test as described by Ranganna (1986). The products were evaluated for colour and appearance, flavour taste, and aroma. The overall acceptability of products was based upon the mean scores obtained from all the characters studied under the organoleptic test. The product with an overall mean score of 7 or above was considered acceptable. The mean scores obtained by different recipes were calculated.

## **Results and Discussion**

The results of experiment pertaining to various aspects of physico-chemical analysis, sensory quality and storage behavior of jam processed from custard apple are summarized as follows:

### **Physico-chemical composition of custard apple fruit after harvesting**

The flesh of custard apple is delicately flavored with a hint of acidity and white-creamish in colour. The custard apple is filled with small segments of flesh containing shiny black seeds and other part of fruit having green bumpy skin.

The average weight, volume, length and diameter of fruits were obtained as 151.29 g, 357.92 cc, 4.97 cm, and 4.01 cm respectively. Almost similar result was obtained by Singh (2005) in custard apple. The average weight of peel 53.18 g, thickness of peel 0.528 cm and the weight of peel recorded as 52.44 g. and weight of pulp 57.89 g Similar findings are shown by Alves *et al.*, (2001) in sugar apple. The average length 0.640 cm, width 0.80 cm, weight 5.02 g, volume of seed 0.309 and number of seeds were recorded as 16.15. The seeds were shiny black in colour. The findings are in line with Singh (2005) in custard apple. The average moisture percentage was found to be 71.19 per cent and pulp to seed ratio comes out as 12:35. The percentage of peel, pulp and seed comes out as 38.81, 37.01 and 4.14, respectively. Similar result was obtained by Alves *et al.*, (2001) in sugar apple.

Among chemical composition of the fruit, total soluble solids was 23.78 per cent, acidity 0.21 per cent, TSS: acid ratio 102.79, total sugar content comes out as 17.10 per cent, reducing sugar 12.99 per cent, non-reducing sugar 3.21 per cent, the ascorbic acid was found to be 38.57 mg/100 g, almost similar results was obtained by Ghosh *et al.*, (2001) in custard apple.

### **Organoleptic evaluation of pulp: water ratio for pulp standardization**

The mean value in respect of pulp: water ratio shows that the T<sub>2</sub> (50:50) ratio was

organoleptically most acceptable as it got the highest score (7.82) followed by T<sub>4</sub> (100:0) pulp water ratio, however T<sub>2</sub>, T<sub>4</sub> and T<sub>1</sub>, T<sub>3</sub> were statistically at par. T<sub>1</sub> (25:75) pulp water ratio was organoleptically least acceptable as it got the least score (7.10) (Table 2).

### **Organoleptic evaluation of custard apple jam at the time of preparation**

Total numbers of treatments were nine, from that to standardize the best recipe, six bottled were kept under each of the treatment (recipe) and six replications per treatment were there. The following results were recorded:

#### **Colour and appearance**

The mean value of colour and appearance revealed that highest score of colour was obtained by T<sub>5</sub> (50% pulp, 75% TSS, 0.3% acidity) followed by T<sub>4</sub> (50% pulp, 75% TSS, 0.2% acidity) however all other treatments showed non-significant difference with each other (Table 3).

#### **Taste and flavor**

The mean value data regarding taste and flavour of jam revealed that T<sub>5</sub> (50% pulp, 75% TSS, 0.3% acidity) was having highest score (8.17). It was significantly more than other treatment in taste and flavour. It is statistically at par with T<sub>4</sub> (50% pulp, 75% TSS, 0.2% acidity). The least score 7.01 was obtained under T<sub>6</sub> (50% pulp, 75% TSS, 0.5% acidity).

#### **Acceptability**

Overall acceptability of the jam is influenced with the levels of acidity and total soluble solids. The data showed that the highest score (8.27) was observed in T<sub>5</sub> (50% pulp, 75% TSS, 0.3% acidity), while the least score (6.57) was obtained by T<sub>9</sub> (50% pulp, 80% TSS, 0.5% acidity).

### **Chemical analysis of different recipes of jam**

For finding the chemical value of processed six bottles of each product were kept under each treatment with three replications and results were obtained as given below. The maximum reducing sugar (58.72%) observed in T<sub>7</sub> (50% pulp, 80% TSS, 0.2% acidity) and minimum reducing sugar (50.83%) found in T<sub>1</sub> (50% pulp, 70% TSS, 0.2% acidity) and maximum non reducing sugar (16.00%) found in T<sub>8</sub> (50% pulp, 80% TSS, 0.3% acidity) and minimum non reducing sugar (10.17%) was found in T<sub>2</sub> (50% pulp, 70% TSS, 0.3% acidity). However, maximum amount of total sugar (75.10%) observed in T<sub>9</sub> (50% pulp, 80% TSS, 0.5% acidity) and minimum amount of total sugar (61.15%) in T<sub>1</sub> (50% pulp, 70% TSS, 0.2% acidity).

Mean value of ascorbic acid revealed that maximum amount of ascorbic acid (12.02%) found in T<sub>9</sub> (50% pulp, 75% TSS, 0.3% acidity) and minimum amount of ascorbic acid (9.47%) was found in T<sub>3</sub> (50% pulp, 70% TSS, 0.5% acidity) (Table 5)

### **Organoleptic evaluation of jam of custard apple during storage**

After standardizing the recipe of jam T<sub>5</sub> (50% pulp, 75% TSS, 0.3% acidity) was found best through sensory evaluation. During storage of squash and jam organoleptic evaluation was recorded at every 30 days interval, starting from the date of preparation and the observations were taken till the acceptability of the product (Table 4).

#### **Colour and appearance**

Mean value revealed that in jam the highest score (8.25) was recorded on D1 (date of preparation). The colour and appearance remained acceptable upto D4 (90 days) with score of 7.10. The least score (6.35) was

obtained on D6 (150 days of storage) that indicate that the colour of the jam was non-acceptable. The decrease in colour in jam during the storage might be due to non enzymatic reaction of organic acid with sugar or oxidation of phenols, which leads to degradation of colour. It may be due to decline in ascorbic acid content.

### **Taste and flavor**

A gradual decrease in taste and flavour during the storage was observed. The highest score (8.46) was recorded on D1 (date of preparation). It was decreased significantly during the storage period. The taste and flavour of jam remained acceptable up to D5 (7.23) (120 days of storage). On D6 (6.49) (150 days of storage), which indicates the non acceptability of the jam as the score was below the minimum limit of acceptability. It might be due to the loss of volatile aromatic substances responsible for taste and flavor, which leads to decrease in the score of taste and flavour in storage of ambient condition. The other possible reasons could be certain biochemical changes occurring under low pH and high temperature that leads to production of off-flavour in the jam.

### **Overall acceptability**

In jam, the highest score (8.59) for acceptability was recorded on D1 (date of preparation) then significant decrease was observed up to D6 (150 days of storage). The jam was remained acceptable up to D5 (120 days of storage) with a score of 7.03. The least score (6.74) was obtained on D6 (150 days of storage) which indicates that the jam was non-acceptable and unfit for consumption as the score was below the minimum acceptability unit.

There are many extrinsic factors that determine the storage ability of product and

temperature play an important role among them. There are certain biochemical changes that occurs under low pH and high temperature that leads to formation of brown pigment and produces off flavour in the processed product.

The other possible reason could be the loss of volatile aromatic substance responsible for taste and flavour, which decreased acceptability on storage at ambient temperature.

### **Chemical changes of standardized product (jam) during storage period**

Chemical analysis of jam was recorded from the date of preparation. The data shows that chemical changes were started from second observation. Chemical changes were started to record at 30 days interval from the data of preparation. For this purpose 48 bottles were kept under each replication and four bottles were analyzed at a time from each replication.

### **Acidity**

It can be revealed from the observation that there was a gradual increase in acidity, during storage since days of storage found to produce significant effect on acidity of jam. In case of jam transformed value 3.29 acidity (inverse transformed value 0.33 per cent) at D1 (date of preparation) was found to be increased significantly up to 4.40 (inverse transformed value 0.59 per cent) at D6 (150 days of storage). The total acidity of jam increased continuously. It might be due to the formation of organic acids by ascorbic acid degradation as well as progressive decrease in pectin content. It is also due to formation of acids from sugar. Similar increase in acidity with increase in storage period was also reported in aonla jam stored for 135 days by Mehta (1995) (Table 6).

**Table.1** Physico-chemical composition of custard apple fruit after harvesting

S. No.	Characters	Mean values
<b>A. Physical composition</b>		
1.	Weight of fruit (g)	151.29
2.	Volume of fruit (ccs)	357.92
3.	Length of fruit (cm)	4.97
4.	Diameter of fruit (cm)	4.01
5.	Weight of seed (g)	5.02
6.	Number of seed	16.15
7.	Length of seed (cm)	0.64
8.	Width of seed (cm)	0.80
9.	Weight of seed (g)	53.18
10.	Thickness of peel(cm)	0.528
11.	Colour of peel	Light green with black spots
12.	Weight of peel (g)	52.44
13.	Pulp percentage	38.81
14.	Peel percentage	37.01
15.	Seed percentage	4.14
16.	Pulp / seed ratio	12:35
17.	Moisture percentage	71.19
18.	Weight of pulp (g)	57.89
19.	Volume of seeds (ccs)	0.309
<b>B. Chemical composition</b>		
1.	Acidity (%)	0.21
2.	Total soluble solids (%)	23.78
3.	Total sugars (%)	17.10
4.	Reducing sugars (%)	12.99
5.	Non-reducing sugar (%)	3.21
6.	Ascorbic acid (mg/100g)	38.57
7.	TSS / acid ratio	102:79

**Table.2** Organoleptic evaluation of pulp: water ratio

S. No.	Treatment	(Pulp : water)	Mean	Rating
1.	T1	(25:75)	7.10 <sup>b</sup>	LM
2.	T2	(50:50)	7.82 <sup>a</sup>	LM
3.	T3	(75:25)	7.19 <sup>b</sup>	LM
4.	T4	(100:0)	7.32 <sup>a</sup>	LM
	<b>SEm±</b>	<b>0.18</b>		
	<b>CD at 5%</b>	<b>0.49</b>		

Note: LM = Like moderately

The superscript letters indicate that the treatment means with same letters are at par at 5% level of significance, while the means with different letters significantly different at 5% level. These letters have been affixed based on CD comparison of treatments means.

**Table.3** Organoleptic evaluation of different recipes of jam from custard apple

Recipes	Colour and appearance	Taste & flavor	Acceptability	Rating
<b>T1 (50% pulp, 70% TSS, 0.2% acidity)</b>	7.40	7.35 <sup>de</sup>	7.56 <sup>fg</sup>	LM
<b>T2 (50% pulp, 70% TSS, 0.3% acidity)</b>	7.82	7.76 <sup>bc</sup>	8.05 <sup>b</sup>	LV
<b>T3 (50% pulp, 70% TSS, 0.5% acidity)</b>	7.82	7.10 <sup>e</sup>	7.90 <sup>cd</sup>	LM
<b>T4 (50% pulp, 75% TSS, 0.2% acidity)</b>	7.95	8.00 <sup>ab</sup>	7.84 <sup>c</sup>	LM
<b>T5 (50% pulp, 75% TSS, 0.3% acidity)</b>	8.10	8.17 <sup>a</sup>	8.27 <sup>a</sup>	LV
<b>T6 (50% pulp, 75% TSS, 0.5% acidity)</b>	7.64	7.01 <sup>ef</sup>	7.75 <sup>e</sup>	LM
<b>T7 (50% pulp, 80% TSS, 0.2% acidity)</b>	7.00	7.45 <sup>cd</sup>	7.51 <sup>g</sup>	LM
<b>T8 (50% pulp, 80% TSS, 0.3% acidity)</b>	7.48	6.93 <sup>f</sup>	6.65 <sup>h</sup>	LS
<b>T9 (50% pulp, 80% TSS, 0.5% acidity)</b>	6.73	6.81 <sup>f</sup>	6.57 <sup>h</sup>	LS
SEm±	<b>0.22</b>	<b>0.12</b>	<b>0.04</b>	
CD at 5%	<b>NS</b>	<b>0.34</b>	<b>0.13</b>	

Note: LV = Like very much, LM = Like moderately, LS = Like slightly

The superscript letters indicate that the treatment means with same letters are at par at 5% level of significance, while the means with different letters significantly different at 5% level. These letters have been affixed based on CD comparison of treatments means.

**Table.4** Organoleptic evaluation of jam during storage up to acceptability

S. No.	Days to storage	Colour and Appearance	Taste and Flavor	Acceptability	Rating
<b>1.</b>	D1 (0 days)	8.25 <sup>a</sup>	8.46 <sup>a</sup>	8.59 <sup>a</sup>	LV
<b>2.</b>	D2 (30 days)	8.00 <sup>b</sup>	8.07 <sup>b</sup>	7.92 <sup>b</sup>	LM
<b>3.</b>	D3 (60 days)	7.45 <sup>c</sup>	7.89 <sup>c</sup>	7.76 <sup>c</sup>	LM
<b>4.</b>	D4 (90 days)	7.10 <sup>d</sup>	7.77 <sup>d</sup>	7.33 <sup>d</sup>	LM
<b>5.</b>	D5 (120 days)	6.83 <sup>e</sup>	7.23 <sup>e</sup>	7.03 <sup>e</sup>	LM
<b>6.</b>	D6 (150 days)	6.35 <sup>f</sup>	6.49 <sup>f</sup>	6.74 <sup>f</sup>	LS
SEm±		<b>0.04</b>	<b>0.03</b>	<b>0.45</b>	
CD at 5%		<b>0.13</b>	<b>0.11</b>	<b>0.13</b>	

Note: LV = Like very much, LM = Like moderately, LS = Like slightly

The superscript letters indicate that the treatment means with same letters are at par at 5% level of significance, while the means with different letters significantly different at 5% level. These letters have been affixed based on CD comparison of treatments means.

**Table.5** Chemical analysis of different recipes of jam from custard apple

Recipes	Acidity (%)	Total Soluble Solids (%)	Reducing Sugar (%)	Non-reducing Sugar (%)	Total Sugar (%)	Ascorbic acid (mg/100 ml)
<b>T<sub>1</sub> (50% pulp, 70% TSS, 0.2% acidity)</b>	0.21	69.90	50.83	10.32	61.15	9.85
<b>T<sub>2</sub> (50% pulp, 70% TSS, 0.3% acidity)</b>	0.30	70.01	51.10	10.17	61.27	10.02
<b>T<sub>3</sub> (50% pulp, 70% TSS, 0.5% acidity)</b>	0.52	70.00	51.12	11.23	62.35	9.47
<b>T<sub>4</sub> (50% pulp, 75% TSS, 0.2% acidity)</b>	0.20	75.00	56.91	13.11	70.02	10.73
<b>T<sub>5</sub> (50% pulp, 75% TSS, 0.3% acidity)</b>	0.33	75.08	55.71	14.36	70.07	11.20
<b>T<sub>6</sub> (50% pulp, 75% TSS, 0.5% acidity)</b>	0.50	75.05	56.53	14.32	70.85	10.88
<b>T<sub>7</sub> (50% pulp, 80% TSS, 0.2% acidity)</b>	0.22	80.01	58.72	15.41	74.13	10.40
<b>T<sub>8</sub> (50% pulp, 80% TSS, 0.3% acidity)</b>	0.30	80.01	58.25	16.00	74.25	9.61
<b>T<sub>9</sub> (50% pulp, 80% TSS, 0.5% acidity)</b>	0.50	80.02	59.21	15.89	75.10	12.02



**Table.6** Effect of storage on chemical constituents of custard apple jam

Days of storage	Acidity (%)	TSS (%)	Sugar (%)			Ascorbic acid (mg/100 ml)
			Reducing	Non-reducing	Total	
D1 (0 days)	3.29 <sup>a</sup> (0.33)	60.02 <sup>a</sup> (75.05)	51.16 <sup>a</sup> (60.65)	22.27 <sup>a</sup> (14.36)	60.02 <sup>a</sup> (75.01)	11.20 <sup>a</sup>
D2 (30 days)	3.48 <sup>b</sup> (0.37)	60.16 <sup>b</sup> (75.25)	51.30 <sup>b</sup> (60.90)	22.25 <sup>a</sup> (14.35)	60.24 <sup>a</sup> (75.35)	11.08 <sup>a</sup>
D3 (60 days)	3.80 <sup>c</sup> (0.40)	60.24 <sup>c</sup> (75.35)	51.55 <sup>c</sup> (61.38)	22.28 <sup>a</sup> (14.40)	60.48 <sup>a</sup> (75.70)	10.89 <sup>b</sup>
D4 (90 days)	4.01 <sup>d</sup> (0.49)	60.41 <sup>d</sup> (75.60)	51.84 <sup>d</sup> (61.80)	22.07 <sup>b</sup> (14.14)	60.64 <sup>a</sup> (76.05)	10.77 <sup>bc</sup>
D5 (120 days)	4.21 <sup>e</sup> (0.54)	60.59 <sup>e</sup> (75.90)	52.06 <sup>e</sup> (62.20)	22.0 <sup>b</sup> (14.06)	60.85 <sup>ab</sup> (76.25)	10.71 <sup>cd</sup>
D6 (150 days)	4.40 <sup>f</sup> (0.59)	60.74 <sup>f</sup> (76.15)	52.28 <sup>f</sup> (62.55)	22.00 <sup>b</sup> (14.02)	61.19 <sup>b</sup> (76.75)	10.59 <sup>d</sup>
<b>SEm±</b>	<b>0.045</b>	<b>0.009</b>	<b>0.030</b>	<b>0.060</b>	<b>0.270</b>	<b>0.045</b>
<b>CD at 5%</b>	<b>0.130</b>	<b>0.130</b>	<b>0.110</b>	<b>0.190</b>	<b>0.830</b>	<b>0.130</b>

1. Figure in parenthesis ( ) are inverse transformed values in per cent unit of the corresponding mean arcsine transformed values
2. The superscript letters indicate that the treatment means with same letters are at par at 5% level of significance.

### **Total soluble solids**

In Jam, initially at the time of preparation 60.02 transformed value (inverse transformed value 75.05 per cent) total soluble solids was observed. It was significantly increased up to storage D6 (150 days of storage) 60.74 transformed value (inverse transformed value 76.15 per cent). This increasing trend of total soluble solids in jam during storage might be due to solubilization of pulp constituents during storage and hydrolysis of polysaccharide. Total soluble solids also increase in papaya jam observed by Saravanan *et al.*, (2004). Slight increase in total soluble solids was also noticed in Jamun jam by Kannan and Thirumaran (2001).

### **Reducing sugar**

In the present study, it was observed that reducing sugar in jam was increased significantly during storage. The initial observation of reducing sugar of jam was 51.16 (inverse transformed value 60.65 per cent) and it increased up to 52.28 (inverse transformed value 62.55 per cent). The rise in reducing sugars might be assigned to the conversion of non-reducing sugar owing to the process of hydrolysis. It might be due to hydrolysis of non-reducing sugars due to the presence of organic acid which might now resulted in degradation of disaccharides to monosaccharides.

### **Non-reducing sugar**

There was a gradual decreasing trend observed with advancement of storage period in case of non-reducing sugar in jam. Initial value recorded was 22.27 (inverse transformed value 14.36 per cent) and decrease was statistically at par up to the D3 22.28 (inverse transformed value 14.40 per cent). At the end of storage D6 (150 days of storage) minimum amount 22.00 (14.02

inverse transformed value per cent) of non-reducing sugar was recorded.

### **Total sugar**

In jam, mean data revealed initially at D1 (date of preparation) total sugar content was 60.02 arcsine transformed value (inverse transformed value 75.01 per cent) and gradual increase was statistically at par with D2 (30 days of storage), D3 (60 days of storage), D4 (90 days of storage) and D5 (120 days of storage) and maximum amount of total sugar 61.19 (inverse transformed value 76.75 per cent) was observed at the end of storage D6 (150 days of storage).

The total sugars showed a gradual increase during storage period in all the processed product of fruits. Similar findings were also reported by Saravanan, *et al.*, (2004) in papaya jam.

### **Ascorbic acid**

During the storage period it is observed that there is continuous decrease in ascorbic acid content both in jam.

In jam, 11.20 mg/100 g ascorbic acid was recorded at D1 (date of preparation) and non significant difference was observed up to D2 (30 days of storage) and minimum amount was observed at D6 10.59 mg (150 days) end of storage period.

Ascorbic acid content of jam decreased continuously during storage. The decline in ascorbic acid content might be due to its degradation into dehydro-ascorbic acid or furfural or hydroxyl methyl furfural at ambient condition. Similar loss of ascorbic acid content during storage was also noticed in aonla jam by Tripathi and Singh (1988) and Manivasagan *et al.*, (2004) in karonda jam.

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