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Quality Evaluation and Preparation of Jam from Sweet Potato Cultivars

Chhama Devi*, Laureate Hynniewta and Surajit Mitra

Department of Post-Harvest Technology of Horticultural Crops, Bidhan Chandra Krishi Viswavidyalaya, Mondouri, Nadia District, West Bengal, India
**Corresponding author*

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A B S T R A C T

A comparative study was done to determine the most suitable combination of two cultivars of sweet potato for jam preparation incorporated within the ratios T_1 = TSP 12-14 (100%), T_2 = TSP 12-8 (100%), T_3 = TSP 12-8 + TSP 12-14 (50% each), T_4 = TSP 12-14 (75%) + TSP 12-8 (25%), T_5 = TSP 12-14 (25%) + TSP 12-8 (75%). All the jam samples prepared from sweet potato were stored in sterilized glass jars and evaluated physico-chemically for ascorbic acid, pH, total soluble solids, reducing sugars and non-reducing sugars, total sugar and sensory evaluation for an interval of 0 day, 30 days, and 60 days. For jam preparation treatment TSP-12-14 (100%) shows better biochemical retentions up to 60 days of storage along with good overall acceptability.

Introduction

Sweet potato (*Ipomoea batatas*) is a dicotyledonous plant which belongs to the family of Convolvulacea. Sweet potato is cultivated extensively for its nutritious and health-promoting values (FAO, 2012; Lee *et al.*, 2012) and also plays an important role in food security. The production reached over 100 million tons in 2014 (FAOSTAT, 2016). Sweet potato is ranked one of the most important food crop after rice, wheat, potato, maize, and cassava (Shekhar *et al.*, 2015). The total production in India is about 1338 thousand tons and area is 110.63 thousands hectare. In West Bengal the area under sweet potato cultivation is 22.85 thousands hectare and production of sweet potato is about 442.28 thousand tons. Sweet potato often considered as an "almost perfectly nourishing food", contains vitamins, iron, calcium, zinc, proteins, minerals, and many other nutrients at favorable ratios (Woolfe, 1992). The starch, crude fiber, protein, ash, and fat of tubes from 80 sweet potatoes varieties had ranges of 42.4–77.3, 1.9–6.4, 1.3–9.5, 1.1–4.9, and 0.2–3.0/100 g of dry matter, respectively (Oboh *et al.*, 1989; Ravindran *et al.*, 1995; Ishida *et al.*, 2000; Mei *et al.*, 2010; Dincer *et al.*, 2011).The development of processed products from sweet potato presents one of the most important key to the expended utilization of the crop. There are a number of products that can be made by using sweet potato as a major ingredient and the development of new and improved processed products from sweet

potato appears to represent an excellent means of increasing the utilization of this high yielding and nutritious crop (Singh *et al.*, 2003). Sweet potato contains water-soluble pectin, which enables its use in making jams and jellies. The process consists of cooking a mixture of 20.7% sweet potato, 45% sugar, 34% water, and 0.3% citric acid until solids content of 68-Brix was reached (Truong *et al.*, 1986). Due to high starch content of sweet potato, compared to fruits, the jam has a slightly different consistency (Truong, 1987). Lila and Babu Nambisan (1991) have reported the abundance of nutrients in sweet potato. Sensory evaluation of fruit flavored sweet potato jam scored high for taste, but gelling consistency was slightly softer than fruit jam due to the high content of starch in the roots.

Materials and Methods

The experiment was carried out in the department of Post-Harvest Technology of Horticultural Crops, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia West Bengal, during the period from 2015-2017. Tubers of sweet potato were obtained from Horticulture Research Station, Bidhan Chandra Krishi Viswavidyalaya, Mondouri, Nadia District, West Bengal.

Preliminary preparation for experiment

The sweet potato tubers were harvested after 120 days of planting, when the tubers latex did not become black after cutting. The following preliminary preparations were done.

Washing

Sweet potato were washed in tap water after that in distilled water containing 50 ppm of chlorine to get rid of any foreign material that may be adhering to the tuber surface and also to reduce the microbial count.

Drying

There after the sweet potato tubers were dried with the help of electric fan.

Methodology of Jam Processing

Evaluation of physico-chemical properties

Moisture content (%)

The sample was dried in drier at 65^0C and initial and final weight was recorded by weighing balance.

$$\%\ \text{moisture} = \frac{\text{Final value} - \text{initial value}}{\text{Initial value}} \times 100$$

Dry matter content (%)

Dry matter of harvested tubers of different cultivars was recorded in gram after drying the samples in drier at 65^0 C for few hours.

Total soluble solid (^{0}B)

A total soluble solid was determined by using a Hand Refract meter from the extract of sweet potato tuber harvested at 120 days after planting.

Ascorbic acid (mg/100g)

Estimated using 2, 6 dichloro-endophenol dye titration method. (Ranganna, 2000). Ascorbic acid reduces the 2, 6-dichlorophenol indophenols dye to a colorless leuco-base.the ascorbic acid gets oxidized to dehydro ascorbic acid.

Though the dye is blue colored compound, the end product is the appearance of pink

color. The dye is pink color in acidic medium. Metaphosphoric acid is used as the titrating agent.

Reducing sugar (%)

Sugar level was determined by copper reduction method (Ranganna, 2000).

Total sugar (%)

Sugar level was determined by copper reduction method (Ranganna, 2000).

Non reducing sugar (%)

Non reducing sugar content was determined by deducting the reducing sugar from the total sugar content.

Sensory evaluation

It was done using the 9 points hedonic score as given by Ranganna (2000).

Results and Discussion

Total soluble solids (^{0}B)

Total soluble solids of jams were successfully controlled according to the desired ranges. In the initial stage the TSS was maintained 68%. There was little amount of variation in the TSS as it was found highest in the treatment T_4 (68.86^{0}Brix) and lowest in T_5 (68.268^{0}Brix). After 60 days of storage it was found that the highest amount of TSS was in the treatment T_2 (70.4^{0}Brix) followed by T_1 (70.35^{0}Brix). The lowest value was noticed in T_4 (69.6^{0}Brix).

Storage effect on TSS was significant which increased from mean value of 68.57% to 70.16%. Respectively after 60 days of storage. Several researchers have observed an increase in total soluble solids of fruit products during storage. This is obviously due to the loss of moisture. The increase in TSS of jam during storage might be due to conversion of polysaccharides into soluble sugars. Similar inferences were drawn by the findings of Manivasagan *et al.*, (2004) in karonda jam.

pH

Results regarding pH of jams after 60 days of storage showed that a range of pH-3.43 to pH-3.5 was recorded with mean of 3.614 initial and 3.467 after 60 days of storage. It was also observed that as the storage period was prolonged, the pH values decreased with a small variation. This may be due to increase in acidity. Panday and Singh (1999) also reported that the higher acidity may account due to lower pH value.

Total sugar content (%)

After 60 days of storage there was significant difference in the total sugar content of jam with maximum value observed in T_1 (32.833%) and minimum in T_3 (32.18%). A decrease in the total sugar content was observed with mean value varies from 32.94% to 32.50%.

Reducing sugars

Reducing sugars showed increasing trend. Minimum value of 23.88% in T_4 and maximum 24.345% T_2 were observed during 60 days of storage respectively. Initial mean value 19.125% of reducing sugars and 24.05% were obtained after 60 days of storage. The increase in reducing sugars is in agreement with Riaz *et al.*, (1999).

Non – reducing sugar (%)

Non reducing sugar decreased in 60 days after storage. A maximum value of 8.640 % in T_1 and minimum of 8.165% in T_2 was observed at 60 days of storage. Mean value of 13.81%

in initial storage days and 8.455 % were obtained after 60 days of storage. Riaz *et al.*, (1999) also observed the same results regarding non-reducing sugars.

Table.1 Effect on TSS, pH, total sugar, reducing sugar, non-reducing sugar, ascorbic acid and Sensory quality of jam during storage

Treatments	Storage Interval (days) Total soluble solids (^{0}B)		
	0	**30**	**60**
T_1	68.388	69.378	70.350
T_2	68.818	69.198	70.498
T_3	68.515	68.853	70.160
T_4	68.868	69.103	69.600
T_5	68.268	69.858	70.228
MEAN	68.57	69.27	70.16
S.Em(±)	0.109	0.132	0.032
C.D.(0.05)	0.33	0.39	0.097

Treatments	Storage Interval (days) pH		
	0	**30**	**60**
T_1	3.638	3.563	3.500
T_2	3.635	3.555	3.495
T_3	3.618	3.538	3.478
T_4	3.583	3.488	3.430
T_5	3.595	3.485	3.430
MEAN	3.614	3.53	3.467
S.Em(±)	0.0064	0.0041	0.0031
C.D.(0.05)	0.019	0.0125	0.0093

Treatments	Storage Interval (days) Total sugar percentage		
	0	**30**	**60**
T_1	33.335	32.873	32.833
T_2	33.165	32.545	32.508
T_3	32.915	32.283	32.180
T_4	32.553	32.530	32.470
T_5	32.723	32.695	32.540
MEAN	32.94	32.58	32.50
S.Em(±)	0.23	0.053	0.049
C.D.(0.05)	NS	0.16	0.149

Treatments	Storage Interval (days) Reducing sugar content (%)		
	0	**30**	**60**
T_1	19.313	21.530	24.188
T_2	19.350	21.710	24.345
T_3	19.228	21.050	23.933
T_4	18.798	20.225	23.888
T_5	18.935	20.748	23.903
MEAN	19.125	21.053	24.05
S.Em(±)	0.036	0.059	0.042
C.D.(0.05)	0.11	0.179	0.127

Treatments	Storage Interval (days) Non reducing sugar content (%)		
	0	**30**	**60**
T_1	14.023	11.343	8.640
T_2	13.815	10.835	8.165
T_3	13.688	11.233	8.248
T_4	13.773	12.305	8.583
T_5	13.788	11.948	8.638

MEAN	13.81	11.533	8.455
S.Em(±)	0.237	0.052	0.071
C.D.(0.05)	NS	0.157	0.214
Treatments	**Storage Interval (days) Ascorbic Acid Content (mg/100gm)**		
	0	**30**	**60**
T_1	26.458	25.848	25.733
T_2	19.315	19.085	18.855
T_3	15.220	15.040	14.720
T_4	17.950	17.620	17.285
T_5	14.580	14.273	14.108
MEAN	18.705	18.37	18.14
S.Em(±)	0.107	0.141	0.176
C.D.(0.05)	0.322	0.426	0.249

Treatments	**Storage Interval (days) Colour**		
	0	**30**	**60**
T_1	8.250	8.000	7.500
T_2	8.000	7.750	7.250
T_3	7.750	7.250	7.000
T_4	8.000	7.750	7.500
T_5	7.750	7.500	7.000
S.Em(±)	0.266	0.237	0.214
C.D.(0.05)	NS	NS	NS

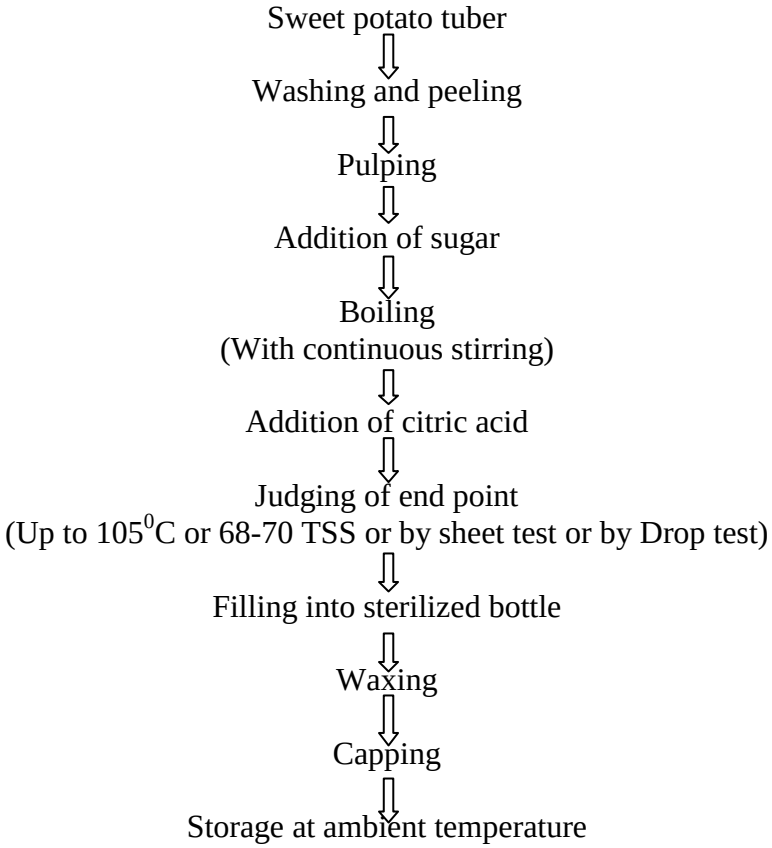
Treatments	**Storage Interval (days) Taste**		
	0	**30**	**60**
T_1	9.000	8.750	8.250
T_2	8.750	8.500	7.750
T_3	8.500	8.250	8.000
T_4	8.250	8.250	7.500
T_5	8.500	8.250	8.000
S.Em(±)	0.24	0.258	0.204
C.D.(0.05)	NS	NS	NS

Treatments	**Storage Interval (days) Overall Acceptability**		
	0	**30**	**60**
T_1	9.000	8.750	8.000
T_2	9.000	8.750	8.000
T_3	8.750	8.500	7.750
T_4	8.500	8.250	7.500
T_5	8.500	8.000	7.750
S.Em(±)	0.214	0.232	0.204
C.D.(0.05)	NS	NS	NS

Recipe (Padmaja and Premkumar, 2002)

Ingredients	Quantity
Sweet potato pulp	1kg
Sugar	900g
Citric acid	10g
Pectin	5g

(Flow Chart for Preparation of Sweet Potato Jam)



Ascorbic acid content (mg/100g)

A gradual decrease was observed after 60 days of storage. Storage mean valued decreased from 18.705mg/100g to 18.14 mg/100g. Highest value was observed in T_1 and lowest in T_5 after 60 days of storage.

The slight reduction in ascorbic acid might be due to oxidation of residual oxygen in glass bottles. Similar results were reported by Karla and Revanthi (1983); Vidhya and Narain (2011) (Table 1).

Sensory profile of sweet potato jam

Colour

The result of present investigation clearly indicated that the colour rating of jam decreased with increases in storage period. It was observed that the colour and appearance slightly decreased from initial day of storage up to 60 days. This might be due to loss of ascorbic acid content due to oxidation reaction during storage. These results corroborated the findings of Hamanan *et al.*, (1980), Baramanray *et al.*, (1995).

Taste

The result for taste indicated that the higher rating 9 was obtained from the treatment T_1 while, minimum rating 8.25 was seen in treatment T_4 during initial days of storage and it was decreased after 60 days of storage with maximum in T_1 (8.25)and minimum in T_4 (7.5). The rating of taste decrease might be due to higher T.S.S value. These findings were in conformity with the results reported by Hamanan *et al.*, (1980); Baramanray *et al.*, (1995).

Overall acceptability

The overall acceptability of jam was dependent on colour or appearance and taste rating of the product. As the period of storage prolonged, the overall acceptability showed a decreasing trend. The possible reason might be due to decrease in rating of colour flavour, taste and texture of jam. These results were supported by the finding of Hamanan *et al.*, (1980), Baramarnaray *et al.*, (1995).

Experiment was conducted by imposing five treatments and four replications. The main objective is to determine the various physical chemical properties of the cultivars. Some results are stated below:

Shelf life of sweet potato was extended by converting into processed products after 60 days of storage.

In jam preparation treatment T_1 shows better biochemical retentions up to 60 days of storage along with good overall acceptability.

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