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Evaluation of Some Sweet Potato Cultivars for Sauce Processing

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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 sauce preparation incorporated within the ratios T_1 = TSP 12-9 (100%), T_2 = TSP 12-10 (100%), T_3 = TSP 12-9 + TSP 12-10 (50% each), T_4 = TSP 12-10 (75%) + TSP 12-9 (25%), T_5 = TSP 12-10 (25%) + TSP 12-9 (75%). All the sauce samples prepared from sweet potato were stored in sterilized glass jars and evaluated physicochemically 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 sauce preparation treatment T_4 = TSP 12-10 (75%) + TSP 12-9 (25%), T_5 = TSP 12-10 (25%) + TSP 12-9 (75%) 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. It is a minor root crop in tropical Africa and despite its industrial potentials as indicated by its growth in terms of production. Among the root and tuber crops, it is the only one that had a positive per capita annual rate of increase in production in Sub-Saharan Africa. 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 plays a major role as a famine reserve for many rural and urban households because of its tolerance to drought, short growth and high yield with limited inputs on relatively marginal soils. Sweet potato is among the world's most important and under-exploited food crops (Scott and Maldonado, 1999; Grant, 2003). Recognizing the great potential of the crop of sweet potatoes in combating malnutrition and food security has resulted in intensified research efforts in recent decades to improve their production and consumption (Queiroga *et al.*, 2007; Laurie *et al.*, 2013). Sweet potato, like other fruits and vegetables, are a rich source of photochemical (Loebenstein and thottappilly, 2009; okuno *et al.*, 1998),

such as carotenoid, flavonoid and other phenolic compounds. Sweet potato is a starchy commodity whose proximate composition, mineral and vitamin content-particularly vitamin A (Woolfe, 1992) is comparable to various fruits. This similarity in composition of sweet potato and fruits served as the basis for development of several food products in Asia like candies, jam, juice, and ketchup sauce (Truong, 1992). The organoleptic score for color, aroma, and taste ranged from 3-4 on a hedonic scale.

According to Santis (1995) a sweet potato sauce containing sweet potato 67.93%, tomato juice (15.10%), vinegar (1.5%), sugar (0.75%), salt (0.50%) and spices (14.19%) had a good organoleptic score with good viscosity and TSS. The sauce can be stored for 2 months at ambient temperature was also acceptable. The product was rich in calcium (34mg), zinc (36mg) and magnesium (10mg).

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

Washing

Sweet potato tubers harvested after 120 days 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 Sauce 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.

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

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 asccorbic 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)

In general, the TSS content in sauce should be stable during storage period.The TSS remains constant may be due to standardization of TSS during the processing. Similar findings were observed by Pruthi *et al.,* (1980) in TSS of tomato ketchup; Bhatnagar *et al.,* (1987) in TSS of tomato ketchup. There was slight difference in TSS content during storage with average mean value of 30.024 during initial days of storage to 30.074 after 60 days of storage.

pH

In general, there has been significant decrease in pH in ketchup after 60 days of storage. The pH was highest in T_1 (3.845) after 60 days of storage and minimum in T_5 (3.238). The decreasing trend of pH may be due to bio-chemical changes taken place amongst the different constituent in sauce hence goes period of sauce. Similar trend was observed by Adsule *et al.,* (1980) in the pH of tomato bottled juice; Chawla *et al.,* (2003) in the pH was carrot chutney.

Total sugar content (%)

In general, the total sugar in sauce recorded gradual increase during storage period. The total sugar was found higher in T_1 (22.685) which was followed by T_5 (22.66) and T_3 (22.655) and T_4 (22.655) as being at par with each other after 60 days of storage.

This trend of total sugar (%) may due to a function of breakdown of insoluble polysaccharides in to simple sugars. Such identical increase in total sugars in various products have been reported by Chattopadhyay *et al.,* (2006) in sweet potato.

Reducing sugar content (%)

In general, the reducing sugars in sauce increased with the advancement of storage period. The reducing sugar was highest in T_5 (12.98%) which was followed by T_2 (12.9%) as being at par with each other after 60 days of storage.

The increasing, might be assigned to the more conversion on non-reducing sugars into invent sugar through the break down process. The similar results are also observed by Gowda *et al.,* (1994) in reducing sugar of tomato puree at the end of 6 months storage.

Non –reducing sugar content (%)

The non-reducing sugars in sauce decreased with the advancement of storage period. The non-reducing sugar was highest in T_3 (9.89%) which was followed by T_4 (9.819%) and T_1 (9.815%) as being at par with each other and minimum was found in T_2 and T_5 (9.68%) after 60 days of storage

(Flow Chart for Preparation of Sweet Potato Sauce)

Sweet potato tuber

⇩

Washing

⇩

Sorting and trimming

⇩

Cutting and chopping

⇩

Heating at 70-90^{0}C for 3-5 minutes (to soften)

⇩

Pulping or extraction of juice/ pulp

⇩

Straining of pulp / juice

⇩

Cooking pulp with 1/3 quantity of sugar

⇩

Putting spice bag in pulp and pressing occasionally

⇩

Cooking to 1/3rd of original volume of pulp/juice

⇩

Removal of spice bag (after squeezing in pulp)

⇩

Addition or remaining sugar and salt

⇩

Cooking

⇩

Judging of end point

⇩

⇩

Addition of vinegar and preservative

⇩

Filling into bottles

⇩

cooling

⇩

Storage at cool and dry place

Table.1 Effect on TSS, pH, total sugar, reducing sugar, non reducing sugar, ascorbic acid and sensory quality of sauce during storage

Treatments	Storage Interval (days) Total soluble solids (^{0}B)		
	0	**30**	**60**
T_1	30.003	30.075	30.111
T_2	30.028	30.078	30.083
T_3	30.080	30.093	30.095
T_4	30.003	30.025	30.038
T_5	30.005	30.020	30.045
MEAN	30.024	30.058	30.074
S.Em(±)	0.0164	0.014	0.011
C.D.(0.05)	0.049	0.042	0.035

Treatments	Storage Interval (days) pH		
	0	**30**	**60**
T_1	3.973	3.938	3.845
T_2	3.920	3.913	3.823
T_3	3.870	3.823	3.805
T_4	3.888	3.818	3.805
T_5	3.873	3.673	3.238
MEAN	3.905	3.83	3.7
S.Em(±)	0.009	0.072	0.008
C.D.(0.05)	0.028	NS	0.024

Treatments	Storage Interval (days) Total sugar percentage		
	0	**30**	**60**
T_1	22.140	22.218	22.683
T_2	22.165	22.195	22.580
T_3	22.143	22.220	22.653
T_4	22.075	22.213	22.655
T_5	22.155	22.190	22.663
MEAN	22.136	22.20	22.64
S.Em(±)	0.018	0.003	0.008
C.D.(0.05)	0.055	0.009	0.026

Treatments	Storage Interval (days) Reducing sugar content (%)		
	0	**30**	**60**
T_1	10.788	11.283	12.868
T_2	11.170	11.988	12.900
T_3	10.955	11.608	12.758
T_4	10.843	11.548	12.838
T_5	10.285	11.263	12.980
MEAN	10.80	11.53	12.86
S.Em(±)	0.018	0.101	0.0152
C.D.(0.05)	0.054	0.306	0.045

Treatments	Storage Interval (days) Non reducing sugar content (%)		
	0	**30**	**60**
T_1	11.353	10.935	9.815
T_2	10.995	10.208	9.680
T_3	11.188	10.613	9.895
T_4	11.233	10.665	9.818
T_5	11.870	10.928	9.683
MEAN	11.33	10.67	9.78
S.Em(±)	0.027	0.10	0.0219
C.D.(0.05)	0.08	0.30	0.066

Treatments	Storage Interval (days) Ascorbic Acid Content (mg/100gm)		
	0	**30**	**60**
T_1	27.790	26.898	25.560
T_2	26.925	26.805	25.525
T_3	27.193	26.468	25.528
T_4	27.050	26.583	25.450
T_5	26.890	26.553	25.055
MEAN	27.17	26.66	25.43
S.Em(±)	0.029	0.024	0.012
C.D.(0.05)	0.089	0.073	0.037

Treatments	Storage Interval (days) Colour		
	0	**30**	**60**
T_1	8.750	8.500	8.250
T_2	8.500	8.250	8.250
T_3	8.750	8.500	8.250
T_4	9.000	8.750	8.500
T_5	8.750	8.500	8.500
S.Em(±)	0.23	0.27	0.266
C.D.(0.05)	NS	NS	NS

Treatments	Storage Interval (days) Taste		
	0	**30**	**60**
T_1	8.750	8.500	8.250
T_2	9.000	8.750	8.500
T_3	8.500	8.500	8.250
T_4	9.000	8.750	8.000
T_5	8.750	8.750	8.250
S.Em(±)	0.20	0.266	0.232
C.D.(0.05)	NS	NS	NS

Treatments	Storage Interval (days) Overall Acceptability		
	0	30	60
T_1	8.750	8.500	8.500
T_2	9.000	8.750	8.750
T_3	8.750	8.250	8.750
T_4	9.000	8.750	9.000
T_5	8.500	8.500	9.000
S.Em(±)	0.204	0.266	0.204
C.D.(0.05)	NS	NS	NS

Recipe (Radhakrishnaiah *et al.*, 1987)

Ingredients	Quantity
sweet potato pulp	750 g
Sugar	150g
Garlic	3g
Onion	30g
Ginger	18g
Chili powder	7g
Black pepper	7g
Cumin powder	6g
KMS	450mg
Vinegar	185ml
Salt	40g

Ascorbic acid content (mg/100gm)

In general, the ascorbic acid (mg/100g) in sauce decreased as the storage period increased. The ascorbic acid was found significantly higher in T_1 throughout storage periodwhich was 27.79 mg during initial days of storage and 25.56mg after 60 days of storage, the minimum was found in T_5.

It may be due to the oxidation process in head space of package.

This result is in agreement with the study of Pruthi *et al.*, (1980) in tomato ketchup at the end of 12 months; Raina *et al.*, (1980) in canned tomato at the end of 6 months; Chattopadhyay *et al.*, (2006) in sweet potato.

Sensory profile of sweet potato sauce

Colour

There has been a decline in colour acceptance score for sauce throughout the storage period. The most acceptable colour was recorded in T_4 and T_5 (8.5) during storage, while while all other treatments was recorded with same score i.e. 8.25 after 60 days of storage. The decline may be attributed to the catalytic effect light on deteriorative in pigment changes either enzymatic or non-enzymatic browning.

These finding are in accordance with that of Kapur *et al.*, (1980) in tomato ketchup; Pruthi (1980) in tomato ketchup.

Taste

The consumer acceptance of food product depends on many factors of which taste is the major parameter. In general, the taste score of sauce declined as the storage period increased. The most acceptable taste was found in T_2 (8.5) which was at par with T_4 (8.0) during the storage period. It may be due to minimum degradative changes of spices added in sauce processing. These results are in conformity with the findings of Raina *et al.*, (1980) in tomato canning (Table 1).

Overall acceptability

In general, overall acceptability score of sauce was declined throughout the storage period. The highest score of overall acceptability of sauce was exhibited in T_4 and T_5 (9.00) during the storage. It declined might be due to varietals effect as well as loss of colour, flavour, texture and taste value of ketchup. Such identical findings were also revealed by Raina *et al.*, (1980) in tomato canning; Bhatnagar *et al.*, (1987) in tomato paste and tomato ketchup.

Experiment was conducted by imposing five treatments and four replications. The main objective is to determine the various physical chemical properties of the cultivars. Treatment T_4 and T_5 shows good biochemical retention and overall acceptability after 60 days of storage.

Thus it can be concluded that processing of sweet potato has to increase shelf life as well as can be used as an alternative to conventional jam and sauce in the market.

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