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JG Jdhao
Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

AP Wagh
Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

RM Modak
Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

VD Tayade
Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

AP Gedam
Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

Corresponding Author:
JG Jdhao
Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India

Effect of different pulp content and TSS concentration on physico-chemical composition of the beetroot syrup

JG Jdhao, AP Wagh, RM Modak, VD Tayade and AP Gedam

Abstract
An investigation on "Effect of different pulp content and TSS concentration on physico-chemical composition of the beetroot syrup" was carried out during the year 2018-19 at Post Harvest Technology Laboratory, Section of Horticulture, College of Agriculture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola with the objectives to study the effect of different pulp content and TSS concentrations on storage behaviour of beetroot syrup. The experiment was laid out in Factorial Completely Randomize with twelve treatment combinations with three replications. The beetroot syrup was filled in 200 ml pre – sterilized glass bottles and stored at ambient storage condition and analysed upto 120 days. From the finding it was observed that, TSS, total sugars, reducing sugars, pH and acidity was increasing trend whereas non – reducing sugars and TSS/acidity ratio in decreasing trend. Syrup prepared with 30% pulp and 70^0 B total soluble solids was found to be the best treatment combination.

Keywords: Pulp, TSS, beetroot, syrup

Introduction
Beetroot (*Beta vulgaris* L.) belongs to the family Chenopodiaceae. It is a important salad vegetable crop of India. Beetroot is the 10^{th} most potential vegetable with respect to disease fighting antioxidant properties and also act as a osmolyte. It is highly nutritive and one of the richest sources of folic acid. It contains carotenoids, saponins, betacynins, polyphenols, flavonoids. Therefore, beetroot ingestion can be considered as a cancer prevention. Beetroot preserve has the beneficial effect of purifying the blood and reduce cholesterol level in blood. In contrast to other fruits, the sugar in beetroot is sucrose, with only small amount of glucose and fructose. As fructose reduces human exercise capacity, a low fructose and a high sucrose content is preferable in sport drinks.

Beetroot contain moisture 87.4 per cent, protein 1.35 per cent, crude fibre 1.9 per cent, iron 0.76 mg per 100 g of pulp, potassium 0.08 mg per 100 g of pulp, zinc 4.9 mg per 100 g of pulp, sodium 73.60 mg per 100 g pulp (Kale *et al.* 2018). TSS is 9^0 B, p^H 6.3, acidity 0.014 per cent, reducing sugar 4.20 per cent, total sugar 7.93 per cent, ascorbic acid 10.01 mg per 100 g of pulp and betalain is 14.20 mg per 100 g of pulp, vitamin C 10. 07 mg per 100 g of pulp (Dabhalkar *et al*, 2015) [2].

Fresh beetroot contains high amount of moisture. Due to this spoilage is rapidly takes place, so it has great potential in processed form. Therefore, development of value-added products could find national and international markets and have great importance in alleviating malnutriton among rural population in addition to several health benefits.

Hence, it is proposed to develop value added syrup from beetroot. This would result in emerging suitable technology for utilization by the processing industries.

Materials and Methods
Beetroot variety Detroit Dark Red with intense colour and fresh fruits with uniform sized procured from the Main Garden, Department of Horticulture, Dr. PDKV., Akola. and brought to the laboratory for further experimentation. Fruits was clean with running water peeled it and cut in small pieces and fed into blender for mashing into fine texture. Thus extracted pulp was used for preparation of syrup with following recipe.

The prepared syrup was analyzed for physico – chemical characteristics upto 120 days of storage.

The pH of syrup was measured by using Perkin Elmer pH meter at 30 ^{0}C temperature. Total soluble solids were determined by using digital refractometer. Titratable acidity was determined by the procedure as reported by Sadasivam and Manickam (1997) [9].

Recipe	Pulp (%)	TSS (^{0}B)
1	25	60
2	30	65
3	35	70
4	40	

The total sugars and reducing sugars were estimated by the spectrophotometer method reported by Sadasivan and Manickm (1997). Factorial completely randomized design (FCRD) was adopted. Observations on various parameters were recorded with three replications.

Result and Discussion

The data presented in Table-1 shows that the pH of beetroot syrup indicating an increasing trend during 120 days of storage. Titratable acidity of beetroot syrup was increase during storage period. Chemical reactions taking place between organic acids and pigments could be responsible for the change in pH. Similar observations were recorded by Reddy and Chikkasubbanna (2009) [7, 8] in amla jam.

Progressive increase in TSS of beetroot syrup during storage was noticed. This might be due to increase in total soluble solids content and caused by hydrolysis of polysaccharides like starch, cellulose and pectin substances into simpler substances. Analogous observations were recorded by Karale (2017) in karonda syrup and Korade *et al.* (2014) [4] in kokum syrup.

The increased in titratable acidity of beetroot syrup increase by adding citric acid and this could be due to the degradation of pectic substances into soluble solids which might have contributed towards increase in acidity. Similar observations were recorded by Tiwari and Bhagawan (2014) in squash prepared from blend of bael pulp and aloe-vera gel and Rathod et al. (2014) [6] in bael RTS blending with aonla.

The data presented in Table-2 shows that the total sugar content of beetroot syrup increases slightly during storage period. The increase in total sugars of beetroot syrup during storage was probably due to conversion of starch into simple sugar. This could be due to hydrolysis of polysaccharide like pectin, starch into reducing sugars. Similar results were observed by Reddy and Chikkasubbanna (2009) [7, 8] amla syrup and Mohire *et al.* (2016) [5] in syrup

In general, there was progressive increase in reducing sugars of beetroot syrup during storage. The increase in reducing sugars of beetroot syrup during storage was probably due to gradual loss of moisture and hydrolysis of polysaccharides into sugars.

Non-reducing sugars of beetroot syrup was decrease during storage period. The decrease in non-reducing sugars of beetroot syrup during storage period might be due to inversion of non-reducing sugars into reducing sugars. There was considerable rise in reducing sugars and corresponding decline in non – reducing sugars. This could be due to inversion of non – reducing sugars into reducing sugars caused by acids present in syrup. Similar phenomenon as noticed by Salari *et al*. (2012) in muskmelon blended pomegranate syrup and squash and Bhandalkar (2013) [1] in lime blended aonla syrup.

Table 1: Change in pH, TSS and Acidity of beetroot syrup during storage due to pulp content and TSS concentrations.

Factors	pH		TSS		Acidity	
Pulp (%)	**Fresh syrup**	**120 days**	**Fresh syrup**	**120 days**	**Fresh syrup**	**120 days**
25 (P1)	6.36	6.55	65.00	68.01	1.14	1.62
30 (P2)	6.38	6.51	65.00	67.62	1.16	1.53
35 (P3)	6.39	6.55	65.00	68.11	1.17	1.59
40 (P4)	6.39	6.57	65.00	67.97	1.18	1.63
F Test	NS	NS	NS	Sig.	Sig.	Sig.
SE,(m) ±	0.131	0.015	0.136	0.056	0.002	0.013
C. D. at 5%	-	-	-	0.164	0.006	0.037
TSS (^{0}B)						
60 (T1)	6.36	6.56	60.00	63.37	1.16	1.57
65 (T2)	6.38	6.55	65.00	67.97	1.16	1.53
70 (T3)	6.39	6.52	70.00	72.44	1.17	1.54
F Test	NS	NS	Sig.	Sig.	Sig.	Sig.
SE,(m) ±	0.113	0.069	0.118	0.048	0.002	0.011
C. D. at 5%	-	-	0.346	0.142	0.005	0.032
Interaction						
P1T1	6.35	6.59	60.00	63.80	1.13	1.65
P1T2	6.37	6.55	65.00	67.98	1.14	1.60
P1T3	6.37	6.51	70.00	72.25	1.15	1.60
P2T1	6.36	6.54	60.00	62.99	1.16	1.55
P2T2	6.38	6.53	65.00	67.81	1.16	1.57
P2T3	6.39	6.48	70.00	72.06	1.16	1.47
P3T1	6.38	6.58	60.00	63.33	1.17	1.53
P3T2	6.39	6.54	65.00	68.29	1.17	1.58
P3T3	6.40	6.55	70.00	72.71	1.17	1.51
P4T1	6.39	6.56	60.00	63.37	1.18	1.54
P4T2	6.40	6.57	65.00	67.81	1.18	1.62
P4T3	6.42	6.57	70.00	72.74	1.19	1.60
F Test	NS	NS	NS	Sig	NS	Sig.
SE,(m) ±	0.226	0.027	0.236	0.097	0.004	0.022
C. D. at 5%	-	-	-	0.284-	-	0.064

Table 2: Change in total sugars of beetroot syrup during storage due to pulp content and TSS concentrations

Factors	Total sugars		Reducing sugars		Non – reducing sugars	
Pulp (%)	Fresh syrup	120 days	Fresh syrup	120 days	Fresh syrup	120 days
25 (P1)	57.25	62.10	19.66	31.85	37.59	28.45
30 (P2)	57.49	59.90	20.66	30.47	36.83	28.08
35 (P3)	57.69	60.74	20.99	32.81	36.70	27.93
40 (P4)	57.87	60.36	21.37	31.44	36.50	27.59
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE,(m) ±	0.021	0.032	0.007	0.021	0.276	0.014
C. D. at 5%	0.061	0.094	0.021	0.063	0.810	0.042
TSS (^{0}B)						
60 (T1)	52.49	55.54	19.63	31.24	32.86	23.31
65 (T2)	58.48	61.16	20.73	31.22	37.75	29.94
70 (T3)	61.78	62.67	21.67	31.22	40.11	32.45
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE,(m) ±	0.018	0.028	0.006	0.019	0.239	0.012
C. D. at 5%	0.053	0.081	0.018	0.054	0.701	0.037

Interaction						
P1T1	52.02	58.18	17.65	30.83	34.37	23.35
P1T2	58.31	62.64	20.18	31.74	38.13	31.20
P1T3	61.45	65.20	21.16	33.00	40.29	32.20
P2T1	52.42	55.10	19.98	31.95	32.44	23.15
P2T2	58.42	59.82	20.53	30.60	37.89	29.22
P2T3	61.66	62.76	21.49	30.90	40.17	31.86
P3T1	52.65	55.31	20.23	32.04	32.42	23.27
P3T2	58.52	61.77	20.89	33.08	37.63	28.69
P3T3	61.90	65.14	21.85	31.98	40.05	31.83
P4T1	52.87	53.60	20.66	31.14	32.21	23.46
P4T2	58.63	62.15	21.29	31.48	37.34	30.67
P4T3	62.13	65.33	22.18	33.69	39.95	31.65
F Test	Sig.	Sig.	Sig.	Sig.	NS	Sig.
SE,(m) ±	0.036	0.056	0.012	0.037	0.478	0.025
C. D. at 5%	0.105	0.163	0.036	0.109	-	0.073

Conclusions

Beetroot syrup prepared from 30% pulp and 70 ^{0}B was found superior than other treatment. The minimum change in TSS, acidity, TSS/acid ratio, reducing sugars, non-reducing sugars, pH and ascorbic acid was found in beetroot syrup treatment combination P_2T_3 (30% pulp and 70^{0}B TSS).

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