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Quality Attributes of Apple and Apricot Blend Juice Preserved with Potassium Sorbate during Storage at Low Temperature

Imtiaz Hussain[1], Alam Zeb[2] and Muhammad Ayub[2]

[1] *Department of Food Science and Technology Faculty of Agriculture Rawalakot Azad Jammu and Kashmir, Pakistan*

[2] *Department of Food Science and Technology, NWFP Agricultural University Peshawar, Pakistan.*

Abstract: This study was carried out to investigate the effect of potassium sorbate on apple and apricot blend juice. The samples were; apple juice (T_1), apricot juice (T_2), 75% apple and 25% apricot juice (T_3), 50% apple and 50% apricot (T_4), 25% apple and 75% apricot juice (T_5). From (T_6) to (T_{10}) above concentrations were repeated with 0.01% potassium sorbate as preservative. The samples were stored at 4℃ for three months and stored juice samples were analyzed for parameters like ascorbic acid, acidity, and pH, total soluble solids, reducing and non reducing sugars, overall acceptability and microbial study after the intervals of 15 days for the period of three months. Ascorbic acid was decreased during storage. Minimum ascorbic acid content was decreased in T_6 (46.42%), while maximum in T_5 (78.26%). Acidity was increased in all treatments maximum acidity increase was recorded for T_1 (46.87%) and minimum for T_9 (30.76%). pH decreased during storage maximum decreased was recorded for T_3 (25.02 %) and minimum for T_6 (11.21%).. The total soluble solids (TSS) (° brix) increased with maximum in T_1 (6.97%) and minimum in T_8 (4.25%). Reducing sugars was increased during storage maximum value regarding reducing sugars was recorded for T_2 (8.82%) and minimum for T_{10} (3.72%). Non-reducing sugars decreased was observed, maximum value observed for T_5 (33.92%) and minimum for T_7 (22.00%).Results regarding overall acceptability showed that maximum mean score observed for T_{10} (5.90) and T_9 (5.30) were found most acceptable in maintaining the sensory characteristics compared to others during storage. Minimum microbial load were observed in T_8 and maximum in T_1 to T_5 (uncountable). Among all the treatments T_9 and T_{10} were most effective in maintaining the sensory and nutritional quality during storage

Key words: Juice, apple, apricot, blend, storage. Sodium benzoate, sensory evaluation

Corresponding Author: Imtiaz Hussain Department of Food Science and Technology Faculty of Agriculture Rawalakot Azad Jammu and Kashmir Pakistan.

E-mail: imti_hussain2005@yahoo.com.

Introduction

The preservation methods used in the self life extension process include water removal, temperature control, freezing, drying, pH control, and irradiation, vacuum packaging, modified atmosphere packaging, aseptic packaging, acidification, fermentation, heating (pasteurization and sterilization) and chemical preservatives addition. The preservation techniques are aimed to slow down the changes, which cause foods deterioration, due to a large number of physical, chemical, enzymatic or biological reactions (Gould, 2000).

Juices are a good source of sugars, vitamins, and minerals; all valuable components to human health. The current food trend toward healthier diets makes juice consumption an important natural food alternative, and improves the availability of its nutritive compounds. The composition of a fruit juice depends on the variety, origin and growing conditions of the fruit, its quality and the processing and storage procedures Fruit and vegetable juices could play an important role in enhancing human health. Preservation is aimed at achieving the self life prolongation of foods. Present tendencies are based on the employment of certain methods which ensure qualitatively products, less preserved, with no additives, with nutritional value, but also safe from the microbiological point of view (Ranken et al., 2005).Soft drinks bottled at low temperatures have high values of the water activity, which allow microbial growth; the pH, the sugar content and the add of preservatives prevent the microorganisms growth in soft drinks. (Stiles,2001). The sorbic acid and the sorbates are the preservatives mostly used in the soft drinks industry. The sorbic acid acts efficiently against the yeasts and moulds growth, and of some bacteria, acting at a low pH, but however continues to be efficient at a pH of 6.5. The microorganisms growth inhibition is achieved through the interaction of the system of the two conjugated double bound in the aliphatic chain with cellular dehydrogenises which most of the yeasts and moulds cannot metabolize (Varnam and Sutherland, 1999). Sorbates are the most effective preservatives against a wide spectrum of food spoilage

microorganisms; they include sorbic acid and potassium sorbate. They are among the safest, most efficient and versatile preservatives used in the food industry today. Sorbates are tasteless and odourless. Because they are non-toxic, they are used in a wide variety of foods, including cheese, yogurt, sour cream, bread, cakes, baking mixes, icing, beverages, margarine, fermented vegetables, fruit products, salad dressing, smoked and salted fish and mayonnaise. The antimicrobial activity of sorbates against molds, bacteria and fungi has been reported by researchers (Sofos,2000). Sorbic acid and its water-soluble salts, especially potassium sorbate, are common food preservatives. Sorbates are the best characterized of all food antimicrobials because of their broad spectrum of action. They effectively inhibit certain bacteria and food-borne yeast and mold species(Sofos, and. Busta 1993). Potassium sorbate has been used as a food-preserving agent since 1945, mostly targeting fungal growth.

Sorbic acid is typically used in foods in the potassium salt form because of its enhanced solubility. It is currently used in cider in a concentration of 0.05 to 0.1% (Davidson, 2002). As with benzoic acid, sorbic acid is more effective at lower pH levels because more will exist in the un dissociated form, allowing entry into the cell (Foegeding and Busta., 1991). The quality and shelf life of fruit juice depend upon a range of internal parameters related to the product and several external factors, packaging being one of them (Mannheim, 1987).Blending increase the taste and flavor of fruit juices (Sistrunk, and Morris, 1985) reported that blend of apple and grape juices were highly acceptable in quality and retained acceptable flavor and colour during storage at 24 ℃ for 12 months. Blending could lead to the production of delightful and delicious beverages with improved organoleptic quality and a high nutritive value. In this study, chemical and organoleptic assessment of blended juice with various proportions of apple and apricot juice was carried out to determine the most acceptable blend organoleptic properties and studied shelf life of such a blend. Considering the antimicrobial activity of Sorbate this study was carried out to determine the microbial, organoleptic and nutritional quality changes of blend juice during storage.

Materials and Methods

Fresh mature and sound apple and apricot were purchased from the local fruit market of Rawalakot and were brought to Food Processing and Analytical Laboratory of the Department of Food Science and Technology, Faculty of Agriculture Rawalakot Azad Jammu and Kashmir, Pakistan where research work was carried out. The fruits were washed followed by sorting, peeling and destoning the juices were extracted using juice extracting machine and filled in glass bottles for the storage study. The treatments were made as (T_1) 100% apple juice (control), (T_2) 100% Apricot juice (control),(T_3) 50% apple+ 50% apricot juice (T_4) 75% apple + 25% apricot juice (T_5) 25 %apple + 75% apricot juice (T_6) 100% Apple juice and 0.1% Potassium sorbate (T_7) 100% apricot juice and 0.1% Potassium sorbate (T_8) 50%apple+50% apricot juice and Potassium sorbate (T_9) 75%apple+25% apricot juice Potassium sorbate (T_{10}) 25 %apple+75% apricot juice and Potassium sorbate. The juice was filled in glass bottle, sealed and stored at refrigeration temperature (4 ℃) for a period of three months.

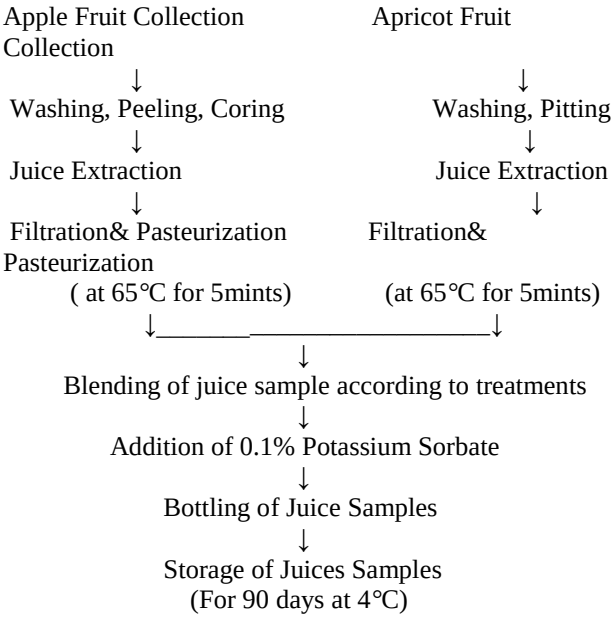

Fig: 1 Flow diagram of apple apricot blend juice stored at 4°C

Chemical analysis . Ascorbic acid was determined by the direct colorimetric method using 2, 6- dichlorophenol-indophenols as decolorizing agent by ascorbic acid in sample extract and in slandered ascorbic acid solution (AOAC, 2004). Acidity was determined by dissolving a known weight of sample in distilled water and titration against 0.01 N NaOH using phenolphthalein as indicator (Srivastava and Sanjeev, 2003). Inolab digital pH meter was used for pH determination. Reducing and non-reducing sucrose was determined by lane Eynon method (AOAC, 2004). The total soluble solids (TSS) were determined by using Abbe refractometer at room temperature (AOAC, 2004).

Sensory evaluation .A panel of ten judges selected from staff and students of food science department evaluated the product fortnightly for color, flavor and overall acceptability by the method of Larmond (1977) using a scale from 1 to 9, where 1 represented extremely disliked and 9 represent extremely liked.

Microbial evaluation (Total fungal count) . Total Fungal Counts (TFC/ml) was determined by slandered dilution plate method using nutrient agar medium (APHA, 1984).

Statistical analysis. The data obtained was subjected to statistical analysis using RCBD (Randomized Complete Block Design) and the means were compared by using LSD (Least Significant Difference) test .(Steel, and Torrie,1980) For all the analyses, the alpha error was set at 0.05%.

Results and Discussion

The results of present study indicated that storage period and temperature had significant effect on ascorbic acid content of different samples. There was a gradual decrease in ascorbic acid of apple and apricot juice. Results show that minimum percent decrease in ascorbic acid content was recorded in sample T_6 (42.46%) and maximum T_5 (78.26 %) (Table1).ranged from 0.34 to 0.36,

Table 1: Effect of sodium benzoate on ascorbic acid of apricot and apple juice stored at 4℃.

	Storage Intervals (Days)								
	Initial	15	30	45	60	75	90	Mean	% Dec.
T_1	5.6	5.0	4.2	3.5	2.8	2.6	1.8	3.64d	67.85
T_2	7.6	7.0	6.0	4.8	4.0	3.1	2.0	4.92b	73.68
T_3	6.5	5.8	5.0	4.2	3.4	2.6	1.7	4.17cd	73.84
T_4	6.8	6.0	5.1	4.3	3.4	2.4	1.6	4.22c	76.47
T_5	6.9	6.0	5.1	4.2	3.3	2.4	1.5	4.20c	78.26
T_6	5.61	5.19	4.79	4.31	4.00	3.49	3.01	4.34c	46.42
T_7	7.61	7.01	6.38	6.00	5.41	4.79	4.00	5.90a	47.36
T_8	6.69	6.01	5.49	5.00	4.31	3.78	3.22	4.92b	52.23
T_9	6.79	6.01	5.48	5.02	4.45	3.92	3.33	5.00b	51.47
T_{10}	6.89	6.11	5.61	5.00	4.29	3.69	3.11	4.95b	55.07
Mean	**6.11ab**	**6.013c**	**5.315cd**	**4.633ac**	**3.936bc**	**3.247ab**	**2.527de**		

The values in column and row followed by different small letters are significantly (P<0.05) different.

Ascorbic acid is the most difficult vitamin to be preserved during pasteurization. As it is the least stable vitamin, it decreases in the product during storage. In a similar study (Viberg et al,1999) reported a decrease in ascorbic acid during they recorded that ascorbic acid in strawberry pulp were affected after treatment involving freezing, heating and accelerated storage. These results are in agreement with the findings of (Viberg et al, 1999) who recorded a change in Chandler variety of strawberries stored at 4℃. Acidity of samples ($T_1$to T_{10}) ranged from 0.34 to 0.36 which were gradually increased to 0.49 to 0.64 during 3 months of storage. The mean values increased from 0.48 to 0.51. Maximum mean values were recorded in sample T_2 (0.51) followed by T_1 and T_{10} (0.48), while minimum mean values were observed in sample T_{10} (0.42). During storage maximum increase was observed in sample T_1 (46.87%), while minimum increase was observed in T_9 (30.76 %) (Table.2). the findings of this study suggest that storage intervals and treatments had a significant effect on acid content of juice during storage. These results are in agreement with the findings of (Nunes et al, 1995) who reported an increase in acidity of strawberry during storage.

Table – 2: Effect of sodium benzoate on acidity of apricot and apple juice stored at 4℃.

Treatments	Storage Intervals (Days)								
	Initial	15	30	45	60	75	90	Mean	% Inc.
T_1	0.34	0.38	0.42	0.48	0.52	0.58	0.64	0.48bc	46.87
T_2	0.36	0.40	0.45	0.55	0.58	0.63	0.65	0.51a	46.61
T_3	0.32	0.36	0.37	0.41	0.45	0.50	0.58	0.42efgh	44.82
T_4	0.30	0.34	0.38	0.43	0.48	0.52	0.56	0.43efg	46.42
T_5	0.32	0.34	0.38	0.41	0.47	0.52	0.54	0.42efgh	46.73
T_6	0.33	0.38	0.42	0.45	0.48	0.50	0.52	0.44ef	36.53
T_7	0.35	0.37	0.39	0.43	0.47	0.49	0.53	0.43efg	33.96
T_8	0.34	0.38	0.42	0.45	0.49	0.51	0.54	0.44def	37.03
T_9	0.36	0.38	0.40	0.42	0.45	0.48	0.52	0.43efg	30.76
T_{10}	0.34	0.36	0.38	0.42	0.46	0.49	0.53	0.42efgh	35.84
Mean	**0.336a**	**0.369c**	**0.412d**	**0.445b**	**0.485ab**	**0.522bc**	**0.561cd**		

The values in column and row followed by different small letters are significantly (P<0.05) different

This increase might be due to the break down of pectin in to pectenic acid. The results are confirmed by the findings of (Riaz et al, 1988). The data showed that different treatment and storage intervals had a significant effect on pH of all samples. The mean pH values of all samples decreased from 4.30 to 2.90 during storage. Maximum decrease was recorded in T_3 (25.02%), while minimum in T_{10} (7.50 %) (Table.3). the acidity is considered one of the physio-chemical properties, which affects both organoleptic and keeping qualities of a product (El Sheikha, 2004).

Table 3: Effect of sodium benzoate on pH of apricot and apple juice stored at 4℃.

Treatments	Storage Intervals (Days)								
	Initial	15	30	45	60	75	90	Mean	% Dec.
T_1	4.30	4.24	4.23	4.15	4.00	3.8	3.30	4.00ab	23.25
T_2	3.80	3.72	3.61	3.5	3.30	3.00	2.90	3.40I	23.68
T_3	4.00	3.94	3.93	3.8	3.50	3.33	3.00	3.64efgh	25.02
T_4	3.85	3.81	3.80	3.7	3.50	3.00	2.90	3.50hI	23.37
T_5	3.95	3.92	3.98	3.8	3.40	3.20	3.00	3.60fgh	24.00
T_6	4.28	4.23	4.20	4.11	4.09	3.90	3.80	4.07a	11.21
T_7	3.90	3.87	3.86	3.80	3.72	3.50	3.30	3.70defg	15.38
T_8	4.00	3.95	3.92	3.87	3.80	3.60	3.50	3.80cde	12.50
T_9	3.90	3.87	3.65	3.58	3.51	3.46	3.40	3.71def	12.85
T_{10}	4.00	3.97	3.92	3.90	3.88	3.80	3.70	3.88bcd	7.50
Mean	**4.098ac**	**3.952bc**	**3.91cd**	**3.821de**	**3.67ac**	**3.459bc**	**3.28ab**		

The values in column and row followed by different small letters are significantly (P<0.05) different.

Decrease in pH-values and increase in total titratable acidity during the cold storage period may be due to activity of some acid-producing bacteria such as *Alicyclobacillus acidoterrestris* (Kang et al, 2003).
The analysis of our data showed that different treatments and storage intervals had a significant effect on TSS of apple and apricot juice. Maximum mean values were recorded in T_2 (10.29) followed by T_7 (10.50), while minimum mean values were recorded T_1 (8.24). Our results indicated a gradual increase in TSS of all samples. Maximum increase was observed in T_1 (6.67%) and minimum in T_8 (4.25%) (Table.4). increased was observed for T_9 (8.45%) and minimum for T1 (2.71%).

Table 4: Effect of sodium benzoate on TSS of apricot and apple juice stored at 4℃.

Treatments	Storage Intervals (Days)								
	Initial	15	30	45	60	75	90	Mean	% Incr.
T_1	8.00	8.00	8.10	8.20	8.30	8.50	8.60	8.24d	6.97
T_2	10.00	10.00	10.10	10.30	10.40	10.50	10.70	10.29a	6.54
T_3	9.00	9.00	9.10	9.20	9.30	9.40	9.50	9.21b	6.26
T_4	9.00	9.00	9.10	9.20	9.30	9.40	9..60	9.22b	6.25
T_5	9.00	9.00	9.10	9.20	9.30	9.40	9..50	9.21b	5.25
T_6	8.00	8.00	8.10	8.30	8.40	8.50	8.70	9.28d	6.85
T_7	10.00	10.00	10.10	10.20	10.30	10.40	10.50	8.11d	5.00
T_8	9.00	9.00	9.10	9.10	9.20	9.30	9.40	10.21a	4.25
T_9	9.00	9.00	9.10	9.10	9.30	9.40	9.50	9.15b	5.26
T_{10}	8.00	8.00	8.10	8.30	8.40	8.50	8.60	9.20b	6.97
Mean	**8.90ab**	**8.90cd**	**9.00bc**	**9.11ac**	**9.22bc**	**9.33cd**	**9.46de**		

The values in column and row followed by different small letters are significantly (P<0.05) different

Sugars are the most important constituent of fruit product and are essential factor for the flavor of the food product and also act as a natural food preservative. Results showed that reducing sugars increased in all samples

during three months of storage. The maximum % the treatments and storage intervals had a significant effect on reducing sugars of the juice. The Maximum mean scores recorded for T_1 (6.90) and minimum for T_7 (6.47) (Table 5).These results are in agreement with (Ruiz-Nieto et al. 1997) who showed an increase in glucose and fructose

Table 5: Effect of sodium benzoate on reducing sugars of apricot and apple juice stored at 4℃.

Treatments	Storage Intervals (Days)								
	Initial	15	30	45	60	75	90	Mean	% Inc.
T_1	6.80	6.86	6.86	6.9	6.94	6.97	6.99	6.90abcd	2.71
T_2	6.2	6.3	6.4	6.45	6.5	6.7	6.8	6.47g	8.82
T_3	6.6	6.7	6.75	6.8	6.9	6.95	6.99	6.81de	5.00
T_4	6.4	6.5	6.6	6.7	6.8	6.9	6.98	6.69f	8.30
T_5	6.7	6.8	6.85	6.9	6.99	7.00	7.1	6.90abcd	5.63
T_6	6.81	6.9	6.95	6.99	6.99	7.00	7.10	6.97ab	5.41
T_7	6.2	6.3	6.4	6.48	6.56	6.65	6.75	6.47g	8.14
T_8	6.5	6.58	6.64	6.72	6.78	6.85	6.90	6.71f	5.97
T_9	6.8	6.9	6.95	6.96	6.98	7.00	7.1	6.95abc	8.45
T_{10}	6.72	6.76	6.8	6.86	6.9	6.95	6.98	6.85d	3.72
Mean	**6.573ac**	**6.66bc**	**6.72cd**	**6.76de**	**6.834df**	**6.897cd**	**6.969ac**		

The values in column and row followed by different small letters are significantly (P<0.05) differ

content in strawberry fruit. The non reducing sugars decrease in all samples the maximum decrees was recorded for T_5 (33.92%) and minimum for T_7(22.00%).The maximum mean value recorded for T_1 (2.68) and minimum for T_3 (1.08) (Table 6). The storage and treatments had significant effect on the non reducing sucrose of the juice stored at refrigeration temperature. These results are confirmed (Ruiz-Nieto et al, 1997) who suggested that sucrose content of the fruit convert to glucose and fructose during the storage, results in the change in sucrose contents of juices

Table 6: Effect of sodium benzoate on non-reducing sugars of apricot and apple juice stored at 4℃.

Treatments	Storage Intervals (Days)								
	Initial	15	30	45	60	75	90	Mean	% Dec.
T_1	2.90	2.80	2.75	2.70	2.60	2.55	2.1	2.68ab	27.58
T_2	2.00	1.90	1.80	1.75	1.64	1.54	1.44	1.77b	28.00
T_3	2.50	2.30	2.10	2.00	1.95	1.90	1.85	1.08b	26.00
T_4	2.60	2.30	2.20	2.00	1.95	1.91	1.85	2.10ab	30.00
T_5	2.80	2.50	2.40	2.30	2.00	1.96	1.85	2.25ab	33.92
T_6	2.90	2.6	2.5	2.4	2.35	2.3	2.25	2.61ab	22.41
T_7	2.00	1.9	1.85	1.82	1.87	1.6	1.56	1.85b	22.00
T_8	2.5	2.2	2.1	2.00	1.97	1.95	1.90	2.08b	24.00
T_9	2.6	2.3	2.1	1.98	1.96	1.93	1.90	2.11b	26.00
T_{10}	2.8	2.5	2.4	2.35	2.25	2.21	2.18	2.40ab	22.14
Mean	**2.56ab**	**2.33cd**	**2.22de**	**2.13ab**	**2.054bc**	**1.985de**	**1.888ef**		

The values in column and row followed by different small letters are significantly (P<0.05) different.

Sensory analysis .The analysis of our data showed that storage period and treatments had a significant on overall acceptability (obtained from color, flavor and odor) of the apple and apricot blend juices. The mean score of judges decrease from 7.78 to 1.00. Maximum mean score of judges was recorded in T_{10} (5.90) followed by T_9 (5.30), while minimum mean score of judges was recorded in T_3 (3.60) followed by T_2 (3.77). Maximum decrease was observed in sample T_1 (87.14%) followed by T_5 (80.26%), while minimum increase was observed in T_7 (42.18%) followed by T_{10} (48.68%), (Table 7). The findings of this study showed that the product overall acceptability during storage. These results are confirmed the loss of flavour and taste may be due to the degradation of ascorbic acid and furfural production (Shimoda and Osajima, 1981; Perez and Sanz, 2001).

Table 7: Effect of sodium benzoate on overall acceptability of apricot and apple juice stored at 4℃.

Treatments	Storage Intervals (Days)								
	Initial	15	30	45	60	75	90	Mean	% Decr.
T_1	7.78	6.5	5.5	4.5	3.00	2.00	1	4.32fg	87.14
T_2	6.3	5.3	4.3	3.5	3.00	2.5	1.5	3.77g	76.19
T_3	7.4	6.4	5.4	4.4	3.6	3.00	2.00	3.60efg	72.97
T_4	7.60	6.6	5.6	4.6	3.5	3.1	2.1	5.15bcde	72.36
T_5	7.6	6.3	5.2	4.2	3.2	2.2	1.5	4.31fg	80.26
T_6	7.7	6.7	5.6	4.8	4.2	3.9	3.5	5.20bcde	54.45
T_7	6.4	6.00	5.5	5.00	4.5	4.00	3.7	5.01cdef	42.18
T_8	7.4	6.4	5.4	4.4	4.00	3.6	3.2	4.91def	56.75
T_9	7.5	6.5	5.7	5.1	4.6	4.1	3.6	5.30bcde	52.00
T_{10}	7.6	7.00	6.5	6.00	5.5	4.8	3.9	5.90abc	48.68
Mean	**7.328ac**	**6.37bc**	**5.47ab**	**4.65cd**	**3.91de**	**3.72bc**	**2.6ef**		

The values in column and row followed by different small letters are significantly (P<0.05) different

Microbial evaluation .Maximum number of colonies recorded in T_1 to T_5 (uncountable during 30 days), while minimum mean growth of microorganism was observed in T_6 (144) T_7 (144) cfu/1 ml (Table 8) who reported the increase number of colonies during storage. Effect of potassium sorbate. Sorbate inhibition of spore germination and outgrowth is known to be pH dependent (Sofos and Busta. 1981, Sofos, 1980). Thus, it was not unexpected to find that sorbate at levels of 1.0, 1.5, and 2.0% (wt/ vol.) at pH 5.7 to 5.8 inhibited either the emergence of vegetative cells or the elongation and cell division of those cells that did emerge. However, at pH 7.0 to 7.2 these levels of sorbate resulted in aberrant cells with defective cell division.

Table 8: Effect of sodium benzoate on non-reducing sugars of apricot and apple juice stored at 4℃.

Treatments	Storage Intervals (Days)								
	Initial	15	30	45	60	75	90	Mean	% Incr.
T_1	14	22	80	96	-----	-----	------		
T_2	13	24	70	83	-----	------	------		
T_3	12	18	72	85	-------	-------	----		
T_4	11	17	70	81					
T_5	12	19	72	85	-----	------	------		
T_6	6	12	77	112	200	280	325	144	98.15
T_7	6	11	76	113	202	285	318	144	98.11
T_8	8	14	70	115	210	290	330	148.16	97.57
T_9	7	13	78	114	205	288	325	147.14	97.84
T_{10}	6	11	76	121	200	292	327	147.57	98.16
Mean	**9.5**	**16.1**	**59.7**	**100.5**	**203.4**	**287**	**325**		

The values in column and row followed by different small letters are significantly (P<0.05) different

Conclusion

From the present study it was concluded that blend juices of apple and apricot with 0.1% sodium benzoate were found most acceptable sensory evaluation and microbial safety and retention of most of the nutrients during 3 months storage at 4℃.Further revealed that % apple +%apricot juice (T_8) and % apple and % apricot (T_{10}) juice blend can be successfully prepared and remain acceptable for three months at4℃ storage.

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