Pak. J. Biochem. Mol. Biol. 2012; 45(1): 6-10

Effect of different chemical preservatives on the storage stability of mango-sea buckthorn blended juice

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Abstract: Comparative studies on the effect of preservatives and storage on overall quality of mango sea buckthorn blended juice were carried out. Juice was prepared from mango and sea buckthorn by mixing their pulp in 7:3. Potassium meta-bisulphite, sodium benzoate and potassium sorbate was added @ 0.06% to first three treatments and in the remaining their mixture was added but the final level were kept the same as 0.06%. All the samples were packed in 250 ml transparent glass bottles and stored at ambient temperature for three months. The samples were analyzed for pH, TSS, % acidity, ascorbic acid, reducing and non-reducing sugars at zero storage and at interval of 15 days up to three months. During storage, TSS and reducing sugars and pH significantly increased while ascorbic acid, non-reducing sugar and acidity significantly decreased during storage.

Keywords: Potassium meta-bisulphite, sodium benzoate, potassium sorbate.
Received: June 15, 2011 **Accepted:** October 22, 2011
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INTRODUCTION

Mango (*Mangifera indica* L.) is one of the oldest and most important tropical fruit. It is cultivated in almost every tropical and sub tropical country. It has originated in a tropical to sub tropical monsoon area in the Himalayan foot hills especially Burma and eastern India. Later on it spread to Africa, Brazil, Caribbean and Central America. Pakistan produces mangoes in large quantities. The main varieties grown in Pakistan are Dusehri, Katha, Chonsa, Anwar Ratual, Malda, Fajri, Saroli, Sindheri, Langra, Desi, Almas, Totapari, and Ting etc [1]. Pakistan produces mangoes in large quantities. Total area under mango cultivation in Pak. was 170.17 thousand hectares and total production was 1727.93 thousand tones during the year 2008-2009. Among this the total area and production of mango in Punjab was 112.41thousand hectares and 1324.88 thousand tones respectively. In Khyber Pukhtunkhwa the area and production of mango was 0.382 thousand hectares and 4.03 thousand tones respectively [2]. Mango is mostly consumed as fresh fruit, but due to its perishable nature it cannot be stored for long time. In order to make the mango fruit available during the off season it is processed to make juices, jams, squashes, nectars, chutney, pickles, toffees, canned mango slices etc[3].

Sea buckthorn (Hippophae) is a unique medicinal and aromatic plant and belongs to the family of Elaeagnaceae. It is a medium sized or small deciduous tree or large shrub with 2.5 – 6 m in height. The main trunk has a thick and rough bark. The young branches are smooth, grey and light ash colored with needle shaped thorns[4]. Studies have shown that the fruit of Sea buckthorn is a storehouse of vitamins and important bioactive substances[5]. The vitamin C content is 5 to 100 times higher than any other fruit or vegetable known. The pulp also contains high quality oil which is regarded to be very important for its medicinal value[6, 7]. The mineral contents of Sea buckthorn make the shrub most important. There is an ample quantity of quality vitamins in Sea buckthorn fruit and leaves. Iron content of Sea buckthorn genotypes of different origins was variables in the range of 22mg/Kg to 282 mg/kg[8].

Keeping in view the above impotence of mango and sea buckthorn, this research work was initiated. The aim of this work was to prepare a consumer acceptable, nutritious and shelf stable mango sea buckthorn blended juice.

MATERIALS AND METHODS

Sound healthy mangoes of proper size and optimum maturity were purchased from the local market of Peshawar and sea buckthorn pulp were arranged from Skardu and were brought to the laboratories of PCSIR Labs complex Peshawar to conduct research work. After washing and sorting pulp was extracted from mangoes with the help of pulper. Blended juice was prepared from mango sea buckthorn pulp (7:3). The formulation of drink was sucrose, pulp & water in the ratio of 1:1:4. The treatment were made as (T_0**)** Control, (T_1) Sodium benzoate 0.06%, (T_2) Potassium metabisulphite 0.06%, (T_3) Sodium benzoate 0.06% + Potassium Sorbate 0.06%, (T_4) Potassium metabisulphite 0.03% + Sodium benzoate 0.03%, (T_5) Potassium metabisulphite 0.03%+ Potassium Sorbate 0.03%, (T_6) Sodium benzoate 0.03% + Potassium Sorbate 0.03%, (T_7) Potassium metabisulphite 0.02% + Sodium benzoate 0.02% + Potassium Sorbate 0.02%.

The drinks were filled in 250ml transparent glass bottles, sealed and stored at room temperature for physico-chemical analysis at interval of 15 days for a total period of 90 days.

Chemical analysis

Total soluble solids were determined by using Abbe refrectometer at room temperature. The ascorbic acid was determined by dye reduction method[9]. Acidity was determined by dissolving a known weight of sample in distill water and titration against 0.01N NaOH using phenolphthalein as indicator[10]. Digital pH meter, PCSIR Karachi made was used for pH determination.

Statistical analysis

The data obtained was subjected to statistical analysis using RCBD (Randomized Complete Block Design) and the means were compared by using LSD, (Lest Significant Difference) test, (Steel and Torrie, 1980) for all the analysis , the α level was set at 0.05%[11,12].

RESULTS AND DISCUSSION

Ascorbic acid

Initially the Ascorbic acid values of the samples (T_0 to T_8) was 45.6, 45.8, 46.2, 44.9, 45.1, 45.3, 45.6, 45.4, and 45.0, which were gradually decreased to 28.1, 32.6, 34.8, 32.7, 35.4, 30.8, 29.4, 30.5 and 31.6 respectively during 90 days of storage. The mean pH value decreased from 46.2 to 28.1 during storage. For treatment maximum mean values were observed in sample T_2 (40.94) followed by T_4 (40.68).

During storage maximum decrease was observed in sample T_0 (38.37%) followed by T_6 (35.52%), while minimum decrease was observed in sample T_4 (21.50%) followed by T_2 (24.67%) (Table 3). These results are also supported by the work of Gillani (2002) who reported 37% and 50% loss of ascorbic acid in mango squash prepared from Fajri and Ting cultivars respectively[13].

TSS

The TSS values of samples (T_0 to T_8) on initial day was 16.1, 16.0, 16.2, 16.3, 16.2, 16.0, 16.1, 16.3 and 16.2° brix, which were gradually increased to 18.5, 18.2, 18.8, 18.9, 18.2, 18.4, 18.8, 18.6 and 18.1° brix respectively during 90 days storage. The mean TSS values increased from 16.15° brix to 18.50° brix during storage. For treatments maximum mean values were recorded in sample T_3 (17.70) followed by T_0 (17.45)° brix. During storage maximum increase was observed in sample T_6 (16.77%) followed by T_2 (16.04%), while minimum increase was recorded in sample T_8 (11.72%) followed by T_4 (12.34%) (Table 1). These results are in agreement with the findings of Islam (1986) who reported an increase in TSS in mango pulp preserved with chemical preservatives[14].

pH

Initially the pH values of the samples (T_0 to T_8) was 3.40, 3.41, 3.42, 3.41, 3.40, 3.41, 3.43, 3.42 and 3.40, which were gradually decreased to 2.06, 2.90, 3.10, 3.02, 2.98, 2.94, 2.88, 2.85 and 2.83 respectively during 90 days of storage. The mean pH value decreased from 3.41 to 2.84 during storage. For treatment maximum mean values were observed in sample T_2 (3.28) followed by T_4 (3.25).

During storage maximum decrease was observed in sample T_0 (39.41%) followed by T_1 (17.88%), while minimum decrease was observed in sample T_2 (9.35%) followed by T_3 (11.43) (Table 2). Our results are in agreement with the finding of Cecilia and Maia (2002) who observed a decrease in pH of high pulp content apple juice during storage[15]. This decrease may be due to the formation of free acids and pectin hydrolysis[16].

Table 1: TSS of mango sea buckthorn blended juice during storage.

Treatments	Storage Interval							%	Mean
	Initial Day	15	30	45	60	75	90		
To	16.1	16.7	17.2	17.6	17.9	18.2	18.5	14.90	17.45^{b}
T_1	16.0	16.3	16.7	17.2	17.6	17.9	18.2	13.75	17.12^{d}
T_2	16.2	16.5	16.8	17.4	17.9	18.5	18.8	16.04	17.44^{b}
T_3	16.3	16.8	17.3	17.8	18.2	18.6	18.9	15.95	17.70^{a}
T_4	16.2	16.4	16.7	17.1	17.4	17.8	18.2	12.34	17.11^{d}
T_5	16.0	16.3	16.5	16.9	17.3	17.8	18.4	15.00	17.02^{e}
T_6	16.1	16.6	16.9	17.4	17.9	18.3	18.8	16.77	17.42^{c}
T_7	16.3	16.7	17.1	17.5	17.7	18.2	18.6	14.11	17.44^{b}
T_8	16.2	16.5	16.8	17.0	17.4	17.8	18.1	11.72	17.11^{d}
Means	16.15^{g}	16.53^{f}	16.88^{e}	17.32^{d}	17.70^{c}	18.12^{b}	18.50^{a}		

Mean followed by different letters are statistically different (P<0.05) using LSD test.

Table 2: pH of mango sea buckthorn blended juice during storage.

Treatments	Storage Intervals							% Dec	Means
	Initial Day	15	30	45	60	75	90		
To	3.40	3.24	3.09	2.76	2.45	2.28	2.06	39.41	2.75^{h}
T_1	3.41	3.36	3.31	3.26	3.14	3.02	2.90	17.88	3.20^{d}
T_2	3.42	3.40	3.36	3.30	3.25	3.18	3.10	9.35	3.28^{a}
T_3	3.41	3.38	3.34	3.26	3.15	3.10	3.02	11.43	3.23^{c}
T_4	3.40	3.41	3.36	3.27	3.18	3.12	2.98	12.35	3.25^{b}
T_5	3.41	3.38	3.30	3.26	3.14	3.08	2.94	13.78	3.21^{d}
T_6	3.43	3.36	3.30	3.22	3.11	2.96	2.88	16.03	3.18^{e}
T_7	3.42	3.35	3.28	3.19	3.10	2.98	2.85	16.66	3.16^{f}
T_8	3.40	3.32	3.24	3.18	3.10	2.92	2.83	16.76	3.14^{g}
Means	3.41^{a}	3.35^{b}	3.28^{c}	3.19^{d}	3.06^{e}	2.96^{f}	2.84^{g}		

Mean followed by different letters are statistically different (P<0.05) using LSD test.

Table 3: Ascorbic acid (mg/100 g) of mango sea buckthorn blended juice during storage.

Treatments	Storage Intervals							% Dec	Means
	Initial Day	15	30	45	60	75	90		
To	45.6	42.2	41.4	38.6	35.5	32.8	28.1	38.37	37.74^{f}
T_1	45.8	43.5	42.1	40.5	38.1	35.3	32.6	28.57	39.70^{c}
T_2	46.2	44.8	42.7	41.1	39.6	37.4	34.8	24.67	40.94 a
T_3	44.9	43.6	41.5	40.2	38.3	36.8	32.7	27.17	39.71^{c}
T_4	45.1	44.2	42.6	40.8	39.1	37.6	35.4	21.50	40.68 b
T_5	45.3	42.9	40.8	38.3	36.5	33.7	30.8	32.08	38.32 e
T_6	45.6	42.3	40.4	36.6	33.1	31.8	29.4	35.52	37.02 g
T_7	45.4	43.1	40.6	37.8	34.2	32.6	30.5	32.81	37.74^{f}
T_8	45.0	44.2	42.3	40.1	37.4	34.1	31.6	29.77	39.24^{d}
Means	45.43^{a}	43.42^{b}	41.60^{c}	39.33^{d}	36.84^{e}	34.67^{f}	31.76^{g}		

Mean followed by different letters are statistically different (P<0.05) using LSD test.

Table 4: Titratable Acidity of mango sea buckthorn blended juice during storage.

Treatments	Storage Intervals							% Inc	Means
	Initial Day	15	30	45	60	75	90		
To	0.40	0.48	0.57	0.65	0.71	0.78	0.85	52.94	0.57^{a}
T_1	0.41	0.42	0.46	0.49	0.53	0.56	0.58	29.31	0.49^{cd}
T_2	0.42	0.44	0.45	0.48	0.55	0.61	0.68	30.00	0.51^{b}
T_3	0.41	0.44	0.46	0.49	0.53	0.56	0.60	30.50	0.49^{cd}
T_4	0.40	0.42	0.45	0.48	0.51	0.56	0.59	32.20	0.48^{d}
T_5	0.42	0.44	0.47	0.50	0.54	0.57	0.62	32.25	0.50^{bc}
T_6	0.43	0.45	0.48	0.51	0.53	0.59	0.61	29.50	0.51^{b}
T_7	0.41	0.43	0.47	0.50	0.55	0.58	0.63	34.92	0.51^{b}
T_8	0.42	0.44	0.46	0.49	0.52	0.56	0.60	30.00	0.50^{bc}
Means	0.41^{g}	0.44^{f}	0.47^{e}	0.51^{d}	0.56^{c}	0.59^{b}	0.64^{a}		

Mean followed by different letters are statistically different (P<0.05) using LSD test.

Titratable acidity

Initially the non-reducing sugar of samples (T_0 to T_8) was 0.40, 0.41, 0.42, 0.41, 0.40, 0.42, 0.43, 0.41 and 0.42, which were gradually decreased to0.85, 0.58, 0.68, 0.60, 0.59, 0.62, 0.61, 0.63 and 0.60 respectively during storage. The mean values for reducing sugar increased from 0.41 to 0.64 during storage. For treatments maximum mean values were recorded in sample T_0 (0.57) followed by T_2, T_6 and T_7 (0.51), while minimum mean values were observed in sample T_4 (0.48) followed by T_1 and T_3 (0.49). Maximum increase was observed in sample T_5 (46.61%) followed by T_0 (45.83%), while minimum increase was observed in sample T_1 (29.31%) followed by T_6 (29.50%) (Table 4). These results are in agreements with the finding of (Nunes et al, 1995) who reported an increase in acidity of strawberry during storage[17].

Sugar acid ratio

Initially the sugar acid ratio of samples (T_0 to T_8) was 40.25, 39.02, 38.57, 39.75, 40.50, 38.09, 37.44, 39.75 and 38.57, which were gradually decreased to 21.76, 31.37, 27.64, 31.50, 30.84, 29.67, 30.82, 29.52 and 30.16 respectively during storage. The mean values for sugar acid ratio decreased from 39.33 to 34.15 during storage. For treatments maximum mean values were recorded in sample T_3 (35.84) followed by T_4 (35.57), while minimum mean values

were observed in sample T_0 (28.94) followed by T_5 (34.07). Maximum increase was observed in sample T_0 (45.93%) followed by T_7 (34.65%), while minimum increase was observed in sample T_6 (17.68%) followed by T_1 (19.60%) (Table 5).). These results are in an agreement with the findings of Daurance *et al*. (1986) who reported a decrease in sugar acid ratio of apple pulp during storage[18].

Reducing sugar

The reducing sugar of (T_0 to T_8) samples on day first was 10.1, 10.2, 10.5, 10.3, 10.1, 10.8, 10.4, 10.6 and 10.9, which were gradually increased to 11.8, 12.4, 13.1, 12.5, 13.4, 14.6, 14.7, 12.8 and 13.4 respectively during storage. The mean values for reducing sugar increased from 12.24 to 17.12 during storage. For treatments maximum mean values were recorded in sample T_7 (13.34) followed by T_6 (12.84), while minimum mean values were observed in sample T_0 (10.81) followed by T_2 (11.22). Maximum increase was observed in sample T_6 (29.25%) followed by T_5 (26.02%), while minimum increase was observed in sample T_0 (15.25%) followed by T_7 (17.18%) (Table 6). The rapid increase in reducing sugar during 90 days can be attributed to the conversion of sucrose to reducing sugars (glucose, fructose etc.) primarily due to acids and higher temperature in jaman syrup similar to those reported Iqbal (1993) in mango pulp[19].

Non reducing sugar

Initially the non-reducing sugar of samples (T_0 to T_8) was 6.43, 7.28, 6.86, 6.74, 6.90, 6.67, 7.12, 6.94 and 6.84, which were gradually decreased to 3.26, 5.18, 4.48, 4.75, 4.84, 4.28, 4.20, 4.32 and 3.88 respectively during 90 days storage. The mean values for non-reducing sugar decreased from 6.86 to 4.35% during storage. For treatments maximum mean values were recorded in sample T_1 (6.20) followed by T_3 (5.82), while minimum mean values were recorded in sample T_0 (5.18) followed by T_8 (5.32) Maximum decrease was observed in sample T_0 (49.30%) followed by T_8 (43.27%), while minimum decrease was observed in sample T_1 (28.84%) followed by T_3 (29.52%) (Table 7). These results are confirmed (Ruiz-Nieto et al, 1997) who reported that sucrose content of the fruit converted to glucose and fructose during storage, results in the change in sucrose content of juice[20].

Table 5: Sugar acid ration of mango sea buckthorn blended juice during storage.

Treatments	Storage Intervals							% Dec	Means
	Initial Day	15	30	45	60	75	90		
To	40.25	34.79	30.17	27.07	25.21	23.33	21.76	45.93	28.94 ^{h}
T_1	39.02	38.81	36.30	35.10	33.20	31.96	31.37	19.60	35.10 ^{c}
T_2	38.57	37.50	37.33	36.25	32.54	30.32	27.64	28.34	34.31 ^{e}
T_3	39.75	38.18	37.60	36.32	34.34	33.21	31.50	20.75	35.84 ^{a}
T_4	40.50	39.04	37.11	35.62	34.11	31.78	30.84	23.85	35.57 ^{b}
T_5	38.09	37.04	36.66	33.80	32.03	31.22	29.67	22.10	34.07 ^{g}
T_6	37.44	36.88	35.20	34.11	33.77	31.01	30.82	17.68	34.18 ^{f}
T_7	39.75	38.43	35.62	35.00	32.18	31.37	29.52	34.65	34.55 ^{d}
T_8	38.57	37.50	35.74	34.69	33.46	31.78	30.16	21.80	34.56 ^{d}
Means	39.33 ^{g}	37.57 ^{f}	35.75 ^{e}	34.22 ^{d}	32.31 ^{c}	30.66 ^{b}	29.25 ^{a}		

Mean followed by different letters are statistically different (P<0.05) using LSD test.

Table 6: Reducing sugar of mango sea buckthorn blended juice during storage.

Treatments	Storage Intervals							% Inc	Means
	Initial Day	15	30	45	60	75	90		
To	10.0	10.4	10.6	10.7	10.9	11.3	11.8	15.25	10.81 ^{i}
T_1	10.2	10.5	10.8	11.2	11.6	11.9	12.4	17.74	11.22 ^{h}
T_2	10.5	10.9	11.4	11.8	12.2	12.7	13.1	19.84	11.80 ^{e}
T_3	10.3	10.5	10.8	11.3	11.7	12.0	12.5	17.60	11.30 ^{g}
T_4	10.1	10.4	10.9	11.6	12.1	12.8	13.4	24.62	11.61 ^{f}
T_5	10.8	11.4	12.1	12.7	13.3	13.8	14.6	26.02	12.67 ^{c}
T_6	10.4	10.9	12.6	13.2	13.9	14.4	14.7	29.25	12.84 ^{b}
T_7	10.6	10.8	11.1	11.3	11.8	12.2	12.8	17.18	13.34 ^{a}
T_8	10.9	11.2	11.6	11.9	12.4	12.7	13.4	18.65	12.01 ^{d}
Means	10.42 ^{a}	10.77 ^{b}	11.32 ^{c}	11.74 ^{d}	12.21 ^{e}	12.64 ^{f}	13.18 ^{g}		

Mean followed by different letters are statistically different (P<0.05) using LSD test.

Table 7: Non reducing sugar of mango sea buckthorn blended juice during storage.

Treatments	Storage Intervals							% Dec	Means
	Initial Day	15	30	45	60	75	90		
To	6.43	5.94	5.21	4.72	4.15	3.61	3.26	49.30	5.18
T_1	7.28	6.93	6.51	6.27	5.82	5.43	5.18	28.84	6.20
T_2	6.86	6.45	6.13	5.71	5.32	4.86	4.48	34.69	5.69
T_3	6.74	6.52	6.26	5.76	5.54	5.18	4.75	29.52	5.82
T_4	6.90	6.47	6.02	5.78	5.34	5.12	4.84	29.85	5.78
T_5	6.67	6.32	6.14	5.61	5.26	4.63	4.28	35.83	5.55
T_6	7.12	6.78	6.34	5.80	5.22	4.63	4.20	41.01	5.73
T_7	6.94	6.45	6.11	5.52	5.24	4.76	4.32	37.75	5.62
T_8	6.84	6.29	5.90	5.36	4.81	4.22	3.88	43.27	5.32
Means	6.86 [a]	6.46 [b]	6.07 [c]	5.61 [d]	5.19 [e]	4.82 [f]	4.35 [g]		

Mean followed by different letters are statistically different (P<0.05) using LSD test.

CONCLUSION

It has been concluded from the present research work that the chemical preservatives have significant effect upon storage period and the sample prepared with combination of chemical preservatives remain acceptable till the end of this research work.

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