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Effects of Different Chemical Preservatives and Antioxidants on Storage Stability of Pomegranate Juice

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ABSTRACT

The aim of current study was to investigate the effects of different chemical preservatives (sodium benzoate, potassium sorbate) and antioxidants (citric acid, ascorbic acid) on storage stability of pomegranate juice. pH and TSS values indicate, that there was no influence of chemical preservatives and antioxidants on pH of pomegranate juice. Furthermore, sensory evaluation concluded that maximum score of color, flavor, taste and overall acceptability was recorded under T3 and minimum values were noted in T6. On the basis of present investigation, it was recommended that pomegranate juice should be preserved in 0.05% sodium benzoate + 0.05 potassium sorbate + 0.1% Citric acid+ 0.05% ascorbic acid to improves the sensorial properties of juice.

Keywords:
Preservatives, antioxidants, pomegranate juice, Total soluble solid

1. Introduction

The central role of fruit crops showed a food security everywhere in the world for people. Basically, they can balance diet based on minerals mineral and vitamins, are highly nutritious and usually delicious. In addition, the increase of the, especially in farming community's fruitlet industry will create jobs. Generally, Pakistan has great impending and inspiring plan to increase the production of fruit for the renewed market and dispensation for both local and spread markets. In addition, the fruit crops are provided to keep the atmosphere friendly nature, gloom, and can easily be added to any agro-forestry platforms (MOARD, 2009).

Pomegranate belongs to punicaceae family and punicoideae subfamily originated from Iran, Himalayas and Northern India. The pomegranate is most important fruit tree around the world. It is cultivated in temperate areas particularly Balochistan, Pakistan. It is grown in various districts of Balochistan such as Khanozai, Kalat, Loralai, Quetta, Ziarat and Mastung. The important pomegranate cultivar grown in Balochistan are Red delicious paper shelled Kabli, Bedana and Kandhari. In addition, Enna and Einsheimer have been introduced as low chilling new varieties (Chaudhry 1994). Pomegranate contains vitamin B (5%) and C (17%), Magnesium (3%), Iron (1%) and Calcium (1%) (Westwood, 1978). A large quantity

of pomegranate fruit is wasted during peak harvesting. In the country a bulk of fruit was wasted might be due to lack of preservation facilities and improper handling at the time of harvesting (Chaudhry 1994).

Even if preserving food might provide a big economic benefit and help avoid surpluses from being wasted in industrialised countries, the danger of rotting could be increased by insufficient communications and transportation as well as a lack of functional storage facilities. Microbes are more likely to proliferate and induce fast oxidation in environments with high temperatures and high humidity, such as the tropics. Under these circumstances, the addition of antioxidants and antibacterial substances has shown to be a useful method for extending the shelf life of foods that are prone to spoilage (Norman et al., 1978).

Alkaline soils and saline soil are very calcareous for the grows pomegranate in most soil. Whenever pomegranate suffer moderate alkaline soils, up to pH 7.5, they like offense acid soil (pH 5.5-6.5). Pomegranates output better on deep medium to heavy soils and heavy loam soil are acceptable if good drainage is provided. Some flooding pomegranates will tolerate. In planting heavy soils on berms (raised mounds of soil) will improve soil yields and aeration. Sandy soils to light are also used in pomegranate cultivation of orchards as long as are well-irrigated (Glozer& Ferguson, 2008).

The edible part of the fruit is called arils. The fresh juice contains 85% moisture and considerable amounts of total soluble solids (TSS), total sugars, reducing sugars, anthocyanins, phenolics, ascorbic acid (vitamin C), proteins and has also been reported to be a rich source of antioxidants (Gil et al., 2000; Kulkarni and Aradhya, 2005). The edible part of the fruit contains considerable amounts of sugars, vitamins, polysaccharides, polyphenols and minerals. In spite of its importance as a semiarid cultivar (cv), little effort has been made in the study of the chemical composition of the edible part of the pomegranate. Some studies have focused on establishing a chemical composition table, mainly of oriental cvs. Studies based of general analysis (total sugars, reducing and non-reducing sugars, total nitrogen, soluble solids content (ssc), titratable acidity (TA), pectin content and ash), of the fruit and its juice have been conducted (Melgarejoet al., 2000).

There are a number of ways for preservation of pomegranate juice. Among them chemical preservation is one of the most useful methods which consequently improves the physical, chemical and nutritional properties and also improves the shelf life of fruit. The sodium metabisulphite, sodium benzoate, sodium propionate, potassium sorbate, potassium metabisulphite, sorbic acid, Sulphur dioxide are used as major chemical preservatives for fruits and vegetables. Preservatives choice mainly depends on cost, safety, properties, quality and chemical effects.

In light of the aforementioned, it was decided that research into the efficacy and appropriateness of various chemical preservatives and antioxidants in the preservation of pomegranate juice was warranted. The objective of this research was to investigate the efficacy and appropriateness of these various preservatives and antioxidants, so the food manufacturers will be able to use the pomegranate they harvest in excess to make juice all year long, cutting down on waste. And when it comes time to harvest, the farmers will be compensated properly.

2. Materials and methods

2.1. Procurement of samples

Good quality, fresh Pomegranate (Kandahari) was bought from the domestic market of Quetta. Evaluation of Pomegranate juice was performed physically (pH and TSS) and organoleptically (Color, Taste, Flavor and overall acceptability) for 75 days of storage at room temperature. The research was performed in the research laboratory of Directorate of Post-Harvest and Food Technology Agriculture Research Institute Sariab Quetta Balochistan.

- **Selection of Fruits**

Disease free and fully ripe fruits of pomegranate were selected.

- **Washing and cleaning**

Pomegranates were washed and undesirable portions were removed.

- **Cutting and cleaning**

Cutting and cleaning of pomegranate were done.

- **Juice extraction**

Pomegranate juice was extracted with the help of electric juicer.

2.2. Preparation of Samples

Pomegranate juice was filled in transparent plastic containers of 1 liter and the chemical preservatives and antioxidants were added as per plan shown in table A. The samples were studied for Physical and Sensory evaluations for a total period of 75 days and data was recorded at every 15 days' interval. The product which gains maximum acceptability on the basis of sensory evaluation were selected for further research work. The data was analyzed organoleptically by using 9 points hedonic scale of Larmond (1978) to choose most acceptable pomegranate juice.

Table 1. Treatment Plan

	Treatment Plan
T_1	0.1 % sodium benzoate + 0.1% Citric acid + 0.05% ascorbic acid
T_2	0.1% potassium sorbate + 0.1% Citric acid+ 0.05% ascorbic acid
T_3	0.05% sodium benzoate + 0.05 potassium sorbate + 0.1% Citric acid+ 0.05% ascorbic acid
T_4	0.075% sodium benzoate+ 0.025 Potassium sorbate + 0.1% Citric acid+ 0.05% ascorbic acid
T_5	0.025% sodium benzoate+0.075 potassium sorbate + 0.1% Citric acid+ 0.05% ascorbic acid
T_6	Control (with no preservatives + antioxidants)

2.3. Extraction of Samples

pH

pH was determined by pH meter.

Total soluble solids

The total soluble solid (TSS) were determined by suggested process of AOAC (2000) using Hand Refract meter.

Organoleptic evaluation

Samples of pomegranate juice were evaluated by a group of ten judges who considered its appearance, aroma, flavour, and overall acceptability. Olimarmond, a nine-point hedonic measure, was employed in the process of creating the ratings (1977).

2.4. Statistical Analysis

In order to do a CRD on all of the treatment and storage interval data, the M-stat C compute programme was used. This analysis was carried out in accordance with Chochkron and Cox's publication (1965). An LSD Test will be used in order to differentiate between the means, as Steel and Torrie have reported (1980).

3. Results and Discussion

3.1. Effect of different chemical preservatives and antioxidants on pH of pomegranate juice

The results of this study are shown in Table 1, which details the effects that a variety of chemical preservatives and antioxidants had on the pH of pomegranate juice. The data indicates after 1st, 15th, 30th, 45th, 60th and 75th days, the pH value of pomegranate juice was recorded as 3.28, 3.15, 3.14, 3.12, 3.10 and 3.05 under T1; 3.33, 3.28, 3.25, 3.22, 3.19 and 3.17 under T2; 3.27, 3.24, 3.23, 3.21, 3.18 and 3.15 under T3; 3.20, 3.17, 3.14, 3.11, 3.09 and 3.04 under T4; 3.28, 3.26, 3.25, 3.22, 3.19 and 3.08 under T5 and 3.19, 3.15, 3.11, 3.07, 3.01 and 2.81 under T6, respectively. On the basis of mean the pH value was recorded as 3.25, 3.20, 3.18, 3.15, 3.12 and 3.05 under T1, T2, T3, T4, T5 and T6, respectively of storage period, the mean pH value was found as 3.14, 3.24, 3.21, 3.12, 3.21 and 3.05 after 1st, 15th, 30th, 45th, 60th and 75th days, respectively. This indicates that there was no influence of chemical preservative antioxidants on pH of pomegranate juice.

According to the results of statistical analysis, the length of time spent in storage as well as the treatments used had a significant impact ($P<0.05$) on the pH level of all of the pomegranate juice samples. The findings of Cecilia and Maia (2002), who found that pomegranate juice with a high pulp content had a lower pH, are

supported by these observations and are consistent with their conclusions.

Table 2. Effect of different chemical preservatives and antioxidants on pH of pomegranate juice

TREATMENT	1st DAY	15DAY	30DAY	45DAY	60DAY	75DAY	MEAN
T1	3.28	3.15	3.14	3.12	3.10	3.05	**3.14BC**
T2	3.33	3.28	3.25	3.22	3.19	3.17	**3.24A**
T3	3.27	3.24	3.23	3.21	3.18	3.15	**3.21AB**
T4	3.20	3.17	3.14	3.11	3.09	3.04	**3.12BC**
T5	3.28	3.26	3.25	3.22	3.19	3.08	**3.21AB**
T6	3.19	3.15	3.11	3.07	3.01	2.81	**3.05C**
MEAN	**3.25A**	**3.20AB**	**3.18AB**	**3.15B**	**3.12BC**	**3.05C**	

	Storage Periods	Treatment
S.E.	0.0451	0.0462
LSD	0.0921	0.0944

3.2. Effect of different chemical preservatives and antioxidants on TSS of pomegranate juice

Results regarding the effect of different chemical preservatives and antioxidants on TSS of pomegranate juice are presented in Table-2. The data indicates after 1st, 15th, 30th, 45th, 60th and 75th days, the TSS of pomegranate juice was recorded as 17, 17.5, 17.5, 18, 19 and 21 under T1; 17, 17, 18, 18.5, 19 and 22 under T2; 17, 17, 19, 20, 22 and 23.5 under T3; 17, 18, 18.5, 19, 19.5 and 20 under T4; 17, 18, 18, 18.5, 20 and 20.5 under T5 and 17, 17.5, 17.5, 18,18 and 18.5 under T6, respectively.

On the basis of mean the TSS value was recorded as 18.33, 18.58, 19.75, 18.66, 18.66 and 17.75 under T1, T2, T3, T4, T5 and T6, the mean TSS value was found as 17, 17.50, 18.08, 18.66, 19.58 and 20.91 after 1st, 15th, 30th, 45th, 60th and 75th days, respectively.

This indicates that there was no influence of chemical preservatives and antioxidants on TSS of pomegranate juice.

To a substantial degree (P 0.05), all of the TSS values of the stored pomegranate juice samples altered in response to the various treatments and lengths of storage. This lends credence to the results of Kinh et al. (2001), who discovered that chemically preserved pomegranate juice had a greater amount of total soluble solids than unpreserved varieties did.

Table 3. Effect of different chemical preservatives and antioxidants on TSS of pomegranate juice

TREATMENT	1DAY	15DAY	30DAY	45DAY	60DAY	75DAY	MEAN
T1	17	17.5	17.5	18	19	21	**18.33AB**
T2	17	17	18	18.5	19	22	**18.58AB**
T3	17	17	19	20	22	23.5	**19.75A**
T4	17	18	18.5	19	19.5	20	**18.66AB**
T5	17	18	18	18.5	20	20.5	**18.66AB**
T6	17	17.5	17.5	18	18	18.5	**17.75B**
MEAN	**17.00D**	**17.50CD**	**18.08CD**	**18.66BC**	**19.58B**	**20.91A**	

	STORAGE PERIODS	TREATMENT
S.E.	0.9367	0.5721
LSD	1.9129	1.1684

3.3 Effect of different chemical preservatives and antioxidants on color of pomegranate juice

Results regarding the effect of different chemical preservatives and antioxidants on color of pomegranate juice are presented in Table-3. The data indicates after 1st, 15th, 30th, 45th, 60th and 75th days, the mean score of color was recorded as 8.66, 8.33, 8.00, 7.66, 7.33 and 7.00 under T1; 8.66, 8.33, 8.00, 8.00, 7.66 and 7.33 under T2; 8.66, 8.66, 8.33, 8.00, 7.66 and 7.33 under T3; 8.66, 8.33, 8.00, 7.66, 7.33 and 7.00 under T4; 8.66, 8.33, 8.00, 7.66, 7.33 and 7.00 under T5 and 8.66, 8.33, 7.66, 7.33, 6.66 and 6.00 under T6, respectively.

On the basis of mean score of color was recorded as 7.83, 7.99, 8.10, 7.83, 7.83 and 7.44 under T1, T2, T3, T4, T5 and T6, the mean score of color was found as 8.66, 8.38, 7.99, 7.17, 7.32 and 6.94 after 1st, 15th, 30th, 45th, 60th and 75th days, respectively. This indicates that maximum score of color was recorded for T3 and minimum score was noted for T6.

The statistical analysis showed that the amount of time spent in storage and the kind of treatment had a significant (P0.05) impact on the overall mean score of coloration for all of the pomegranate juice samples. A possible explanation for the drop in colour ratings is that Millard response acceleration occurred during storage.

Table 4. Effect of different chemical preservatives and antioxidants on color of Pomegranate juice

TREATMENT	1DAY	15DAY	30DAY	45DAY	60DAY	75DAY	MEAN
T1	8.66	8.33	8.00	7.66	7.33	7.00	**7.83B**
T2	8.66	8.33	8.00	8.00	7.66	7.33	**7.99AB**
T3	8.66	8.66	8.33	8.00	7.66	7.33	**8.10A**
T4	8.66	8.33	8.00	7.66	7.33	7.00	**7.83B**
T5	8.66	8.33	8.00	7.66	7.33	7.00	**7.83B**
T6	8.66	8.33	7.66	7.33	6.66	6.00	**7.44C**
MEAN	**8.66A**	**8.38AB**	**7.99AB**	**7.17B**	**7.32B**	**6.94C**	

3.4. Effect of different chemical preservatives and antioxidants on flavor of pomegranate juice

Results regarding the effect of different antioxidants and chemical preservatives on flavor of pomegranate juice are presented in Table-4. The data indicates after 1st, 15th, 30th, 45th, 60th and 75th days, the mean score of flavor was recorded as 8.66, 8.33, 8.00, 7.66, 7.33 and 7.00 under T1; 8.66, 8.33, 8.00, 7.66, 7.33 and 7.00 under T2; 8.66, 8.33, 8.00, 7.66, 7.33 and 7.00 under T3; 8.33, 8.00, 7.66, 7.33, 7.00 and 6.66 under T4; 8.33, 8.00, 7.66, 7.33, 7.00 and 6.66 under T5 and 8.66, 8.33, 7.33, 7.00, 6.33 and 6.00 under T6, respectively.

On the basis of mean score of flavor was recorded as 7.83, 7.83, 7.83, 7.49, 7.49 and 7.27 under T1, T2, T3, T4, T5 and T6, the mean score of flavor was found as 8.55, 8.22, 7.77, 7.44, 7.05 and 6.72 after 1st, 15th, 30th, 45th, 60th and 75th days, respectively.

This indicates that maximum score of flavor was recorded for T3 and minimum score was noted for T6.

According to the findings of the statistical analysis, the mean taste score of all of the pomegranate juice samples changed considerably (p0.05) while they were being stored, and this was dependent on the storage intervals and treatments. Research conducted by Chuha et al. (1993) shown that the flavour of pomegranate juice that had been preserved with potassium metabisulphite or a combination of preservatives was unaffected by the passage of time.

Table 5. Effect of different chemical preservatives and antioxidants on flavor of pomegranate juice

TREATMENT	1DAY	15DAY	30DAY	45DAY	60DAY	75DAY	MEAN
T1	8.66	8.33	8.00	7.66	7.33	7.00	**7.83A**
T2	8.66	8.33	8.00	7.66	7.33	7.00	**7.83A**
T3	8.66	8.33	8.00	7.66	7.33	7.00	**7.83A**
T4	8.33	8.00	7.66	7.33	7.00	6.66	**7.49B**
T5	8.33	8.00	7.66	7.33	7.00	6.66	**7.49B**
T6	8.66	8.33	7.33	7.00	6.33	6.00	**7.27C**
MEAN	**8.55A**	**8.22B**	**7.77BC**	**7.44BC**	**7.05C**	**6.72D**	

3.5. Effect of different chemical preservatives and antioxidants on taste of pomegranate juice

Results regarding the effect of different chemical preservatives and antioxidants on taste of pomegranate juice are presented in Table-5. The data indicates after 1st, 15th, 30th, 45th, 60th and 75th days, the mean score of taste was recorded as 8.33, 8.00, 7.66, 7.33, 7.00 and 6.66 under T1; 8.66, 8.33, 8.00, 7.66, 7.33 and 7.00 under T2; 8.66, 8.33, 8.00, 7.66, 7.33 and 7.00 under T3; 8.33, 8.00, 7.66, 7.33, 7.00 and 6.66 under T4; 8.33, 8.00, 7.66, 7.33, 7.00 and 6.66 under T5 and 8.66, 8.33, 7.33, 6.66, 6.00 and 5.60 under T6, respectively.

On the basis of mean score of taste was recorded as 7.49, 7.83, 7.83, 7.49, 7.49 and 7.09 under T1, T2, T3, T4, T5 and T6, the mean score of taste was found as 8.49, 8.16, 7.71, 7.32, 6.94 and 6.59 after 1st, 15th, 30th, 45th, 60th and 75th days, respectively. This indicates that maximum score of taste was recorded for T2and T3 and minimum score was noted for T6.

Table 6. Effect of different chemical preservatives and antioxidants on taste of pomegranate juice

TREATMENT	1DAY	15DAY	30DAY	45DAY	60DAY	75DAY	MEAN
T1	8.33	8.00	7.66	7.33	7.00	6.66	**7.49B**
T2	8.66	8.33	8.00	7.66	7.33	7.00	**7.83A**
T3	8.66	8.33	8.00	7.66	7.33	7.00	**7.83A**
T4	8.33	8.00	7.66	7.33	7.00	6.66	**7.49B**
T5	8.33	8.00	7.66	7.33	7.00	6.66	**7.49B**
T6	8.66	8.33	7.33	6.66	6.00	5.60	**7.09C**
MEAN	**8.49A**	**8.16B**	**7.71C**	**7.32C**	**6.94D**	**6.59D**	

3.6. Effect of different chemical preservatives and antioxidants on overall acceptability of pomegranate juice

Results regarding the effect of different chemical preservatives and antioxidants on overall acceptability of pomegranate juice are presented in Table-6. The data indicates after 1st, 15th, 30th, 45th, 60th and 75th days, the mean score of overall acceptability was recorded as 8.66, 8.33, 8.00, 7.66, 7.33 and 6.66 under T1; 8.33, 8.00, 7.66, 7.33, 7.00 and 7.00 under T2; 8.66, 8.33, 8.00, 7.66, 7.33 and 7.00 under T3; 8.33, 8.00, 7.66, 7.33, 7.00 and 6.66 under T4; 8.33, 8.00, 7.66, 7.33, 7.00 and 6.66 under T5 and 8.33, 8.00, 7.33, 6.66, 6.00 and 5.66 under T6, respectively. On the basis of mean score of overall acceptability was recorded as 7.77, 7.55, 7.83, 7.49, 7.49 and 6.99 under

T1, T2, T3, T4, T5 and T6, the mean score of overall acceptability was found as 8.44, 8.11, 7.71, 7.32, 6.94 and 6.60

after 1st, 15th, 30th, 45th, 60th and 75th days, respectively. This indicates that maximum score of overall acceptability was recorded for T3 and minimum score was noted for T6.

The overall acceptability of pomegranate Juice samples underwent a substantial shift, as measured by the mean

score, across a variety of various storage durations and treatments (P 0.05). These results are consistent with those that were discovered by Kinhet et al. (2001), who discovered that preserving juice using potassium metabisulfite resulted in a longer shelf life for the juice. During storage at room temperature, the greatest overall acceptability of the product is preserved due to the maximum nutritional stability, the lowest possible number of microorganisms, and the highest possible sensory value.

Table 7. Effect of different chemical preservatives and antioxidants on overall acceptability of pomegranate juice

TREATMENT	1DAY	15DAY	30DAY	45DAY	60DAY	75DAY	MEAN
T1	8.66	8.33	8.00	7.66	7.33	6.66	**7.77AB**
T2	8.33	8.00	7.66	7.33	7.00	7.00	**7.55BC**
T3	8.66	8.33	8.00	7.66	7.33	7.00	**7.83A**
T4	8.33	8.00	7.66	7.33	7.00	6.66	**7.49C**
T5	8.33	8.00	7.66	7.33	7.00	6.66	**7.49C**
T6	8.33	8.00	7.33	6.66	6.00	5.66	**6.99D**
MEAN	**8.44A**	**8.11B**	**7.71BC**	**7.32C**	**6.94CD**	**6.60D**	

4. Conclusions

According to the findings of the present research, it was found that the perceptual qualities of pomegranate juice could be improved by preserving it in a solution that included 0.05% sodium benzoate, 0.05% potassium sorbate, 0.1% citric acid, and 0.05% ascorbic acid. This was determined based on the findings of the study that is being discussed. The mean pH value was recorded as 3.25, 3.20, 3.18, 3.15, 3.12 and 3.05under T1, T2, T3, T4, T5 and T6, respectively. In case of storage period, the mean pH value was found as 3.14, 3.24, 3.21, 3.12, 3.21 and 3.05after 1st, 15th, 30th, 45th, 60th and 75th days, respectively. This indicates that there was no influence of chemical preservatives and antioxidants on pH of pomegranate juice. The mean TSS value was recorded as 18.33, 18.58, 19.75, 18.66, 18.66 and 17.75under T1, T2, T3, T4, T5 and T6, respectively. In case of storage period, the mean TSS value was found as 17, 17.50, 18.08, 18.66, 19.58 and 20.91 after 1st, 15th, 30th, 45th, 60th and 75th days, respectively. This indicates that there was no influence of chemical preservatives and antioxidants on TSS of pomegranate juice. The mean score of color was recorded as 7.83, 7.99, 8.10, 7.83, 7.83 and 7.44 under T1, T2, T3, T4, T5 and T6, respectively. In case of storage period, the mean score of color was found as 8.66, 8.38, 7.99, 7.17, 7.32 and 6.94 after 1st, 15th, 30th, 45th, 60th and 75th days, respectively. The mean score of flavor was recorded as 7.83, 7.83, 7.83, 7.49, 7.49 and 7.27 under T1, T2, T3, T4, T5 and T6, respectively. In case of storage period, the mean score of flavor was found as 8.55, 8.22, 7.77, 7.44, 7.05 and 6.72 after 1st, 15th, 30th, 45th, 60th and 75th days, respectively. The mean score of taste was recorded as 7.49, 7.83, 7.83, 7.49, 7.49 and 7.09 under T1, T2, T3, T4, T5 and T6, respectively. In case of storage period, the mean score of taste was found as 8.49, 8.16, 7.71, 7.32, 6.94 and 6.59 after 1st, 15th, 30th, 45th, 60th and 75th days, respectively. The mean score of overall acceptability was recorded as 7.77, 7.55, 7.83, 7.49, 7.49 and 6.99 under T1, T2, T3, T4, T5 and T6, respectively. In case of storage period, the mean score of overall acceptability was found as 8.44, 8.11, 7.71, 7.32, 6.94 and 6.60 after 1st, 15th, 30th, 45th, 60th and 75th days, respectively.

Declaration of Interest

The author declared no conflict of interest.

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