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Effect of replacement of citric acid with lactic acid on vitamin-C and sensory characteristics of ready to serve apple drink during storage

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Abstract
In the present study, the citric acid content of ready to serve apple drink was replaced with lactic acid in the ratios; T_1 (0%), T_2 (0.05%), T_3 (0.10%), T_4 (0.15%) and T_5 (0.20%). After pasteurization, the juice samples were filled and stored in pre-sterilized capped bottles for 60 days. The results revealed that vitamin-C, color, flavor, taste and overall acceptability were decreased significantly during storage period. Vitamin-C and color remained stable in all the treatments while T_3 showed the best results regarding flavor, taste and overall acceptability.
Keywords: Apple drink, Citric acid, Lactic acid; Storage, Sensory characteristics.

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Introduction

Fruit juices and purees are defined as the products obtained by mechanical processing of fresh fruits. Apple (*Pyrus malus*) belonging to the family *Rosaceae*, is an important fruit and is liked throughout the world by all classes of the people due to its established nutritional economical value. Apple has been widely utilized as a food from the earliest time and is well known for its curative characteristics. It has cholesterol-reducing effect. For many years, especially in Europe, apple has been used to treat infant's intestinal disorders such as diarrhea and dysentery [1].

Apple is consumed in many different ways. In apple growing areas, a smaller quantity of raw fruit is used as a vegetable. But mostly it is made into preserves like pies, jams, jellies, fresh and preserved apple juice and cider or vinegar. On this account it has universal and worldwide consumption.

A beverage is a liquid for drinking and the beverage industry is broad and complex. As world population increases, the problem of providing wholesome beverages increases and opportunity for improving through beverages become greater in many areas of the world. Beverages provide a tremendous opportunity for people of all ages to enjoy life more; they provide quick energy and in some cases they improve nutrition [2].

Acidity in fruit beverages balances sweetness and improves bacterial stability. In addition to the acid of the formulated fruit proportion, added acids are commonly used in fruit drinks mainly citric acid, tartaric acid and malic acid. Citric acid is a weak organic acid found in citrus fruits. It is a good natural preservative and is also used to add an acidic (sour) taste to foods and soft drinks. It is also used as a flavoring agent and acts as a preservative in food and beverages, especially soft drinks.

Lactic acid's entry among acidulants is a recent one but it has proved to be more effective, tasteful and a strong preservative of food products for a pretty long period comparatively. Because of having many merits and versatile usages lactic acid has gained much more popularity. Its consumption covers the vast range of drinks, food products of different types. It has a pleasant taste. Its flavor is also remarkable. It can also be utilized in calcium-enriched products. Being easily soluble, it is used in sports drinks. Lactic acid being liquid, its portability and handling is quite convenient. It also has the quality of pH regulation. Use of buffered lactic acid improves the taste and flavor of many beverages; such as soft drinks, mineral water, carbonated fruit juices etc [3]. Its use can preserve the processed food products for a pretty long period. Moreover, the flavor profile of most products can be significantly improved by using a mixture of acidulants. The use of a mixture of acidulants makes the flavor profile more authentic. This project was designed to replace citric acid partially with lactic acid to prepare ready to serve apple drink. The main object of this study was to produce the product with the improved flavor and taste and to find an effective combination of citric acid and lactic acid with more promising flavor and storage life.

Materials and Methods

Research work has been done in the National Institute of Food Science and Technology, University of Agriculture, Faisalabad Pakistan.

Procurement of raw material

The fresh Kala Kullu variety of apple fruit was procured from the local market of Faisalabad. The fruit was thoroughly washed with potable water to remove dirt, dust and pesticide residues and also to reduce microbial load. The apples were selected on the basis of uniformity for pulp extraction whereas over ripe and damaged fruits were discarded.

Preparation of pulp

The apples were cut into pieces. These cut pieces of apples were boiled in water so that they become soft. These soft apple pieces were passed through the pulper to extract the pulp. This pulp was filled in plastic cans, chemically preserved for its use in preparation of apple drink later on required during the experiment.

Preparation of apple drink

The apple drink was prepared by using the pulp. The drink thus obtained was pasteurized and then different combinations of lactic acid and citric acid were added. Trials of different combinations of citric acid and lactic acid were carried out and the best suited combinations for stability and acceptability of the product were selected as shown in Table 1.

Packaging and storage

The sample containing different proportions of citric acid and lactic acid was stored in cleaned and already washed sterilized glass bottles with 250 ml capacity. These filled bottles were sealed with crown cork by manually operating capping machine. The samples were stored at room temperature for 60 days and were analyzed after the fifteen days interval.

Ascorbic acid determination

Ascorbic acid was determined according to the method of Ruck [4] by using 2,6-dichlorophenole indophenols.

Evaluation of sensory properties

The juice under each treatment organoleptically was evaluated for color, flavor, taste and overall acceptability by the Hedonic Scale method as described by Larmond [5]. A trained panel of 20 judges was selected for the sensory evaluation from the National Institute of Food Science and Technology, University of Agriculture, Faisalabad.

Statistical analysis

For statistical analysis, a completely randomized design (CRD) was used with a factorial arrangement and significant differences between mean values were determined by LSD pairwise comparison test at a significance level of $p<0.05$. Statistical analyses were conducted using Statistix 9.0 software (Analytical Software, Tallahassee, FL, USA).

Results and Discussion

Treatments effect on vitamin-C and sensory properties

The results regarding the effects of different combinations of citric acid and lactic acid on vitamin-C, color, flavor, taste and overall acceptability of ready to serve apple drink are depicted in the Table 2. No significant effect of any treatment was observed on vitamin-C and color while the treatments T_1, T_2 and T_3 for flavor and overall acceptability and treatment T_3 for taste were more liked by all the members of panel. The decrease in mean score values for flavor, taste and overall acceptability was observed in T_4 and T_5 as evaluated by the trained panel of judges. It was observed that the maximum decrease in mean score value for flavor, taste and overall acceptability was found in T_5 while maximum increase was found in T_3. These results suggested that the treatment T_3 with combination of 0.10 percent of both lactic acid and citric acid was the best of all treatments. The other treatments were ranked in between, some members of panel liked and others not liked as indicated in the results.

Table 1: Specification of different treatments.

Treatments	Citric acid	Lactic acid
T_1	0.20%	0%
T_2	0.15%	0.05%
T_3	0.10%	0.10%
T_4	0.05%	0.15%
T_5	0%	0.20%

Storage effect on vitamin-C and sensory properties

The results regarding effect of storage on vitamin-C, color, flavor, taste and overall acceptability of ready to serve apple drink during 60 days are presented in the Table 3. We observed the significant decrease in vitamin-C from zero to 60 days of storage. The degradation of ascorbic acid in

different fruit products during processing, preservation, packaging, storage and handling has also been reported by Uddin et al. [6], Ullah [7], Skalskai and Sistrunk [8], Saito et al. [9], El-Warraki et al. [10], Wartenberg [11], Lee et al. [12], Podgorska et al. [13], Pruthi et al. [14], El-Ashwah et al. [15], Godara and Pareek [16] which support our observations. The degradation of vitamin-C was might be attributed to the storage time, temperature, exposure to light and the presence of atmospheric oxygen in the head space [17]. These factors may adversely affect the vitamin-C of apple drink during storage which ultimately cause its loss.

We also observed that no significant changes in mean score values for color and flavor of apple drink were occurred during first 7 days which were then decreased significantly during 60 days of storage while the mean score values for taste and overall acceptability were decreased from zero to 60 days of storage.

Table 2: Effect of Treatments on vitamin-C and sensory properites in ready to serve apple drink.

Treatments	Vitamin-C	Color	Flavor	Taste	Overall acceptability
T_1	4.90a ± 0.10	7.38a ± 0.09	7.22a ± 0.13	6.98b ± 0.13	7.34a ± 0.09
T_2	4.88a ± 0.11	7.36a ± 0.11	7.24a ± 0.10	7.12ab ± 0.10	7.33a ± 0.13
T_3	4.90a ± 0.13	7.38a ± 0.06	7.24a ± 0.11	7.40a ± 0.14	7.36a ± 0.12
T_4	4.88a ± 0.12	7.36a ± 0.14	6.22b ± 0.14	6.18c ± 0.15	5.98b ± 0.10
T_5	4.91a ± 0.10	7.37a ± 0.12	5.08c ± 0.16	5.12d ± 0.17	5.22b ± 0.14

Means followed by the same letter within each column are not significantly different ($P < 0.05$).
T1: Citric acid – 0.20%, Lactic acid – 0%. T2: Citric acid – 0.15%, Lactic acid – 0.05%. T3: Citric acid – 0.10%, Lactic acid – 0.10%.
T4: Citric acid – 0.05%, Lactic acid–0.15%. T5: Citric acid – 0%, Lactic acid – 0.20%.

Table 3: Effect of storage on vitamin-C and sensory properties in ready to serve apple drink

Storage days	Vitamin-C	Color	Flavor	Taste	Overall acceptability
0	4.89a ± 0.15	7.26a ± 0.17	6.86a ± 0.18	6.84a ± 0.13	6.80a ± 0.14
15	4.67b ± 0.13	7.20a ± 0.13	6.74a ± 0.19	6.68ab ± 0.11	6.72ab ± 0.11
30	4.35c ± 0.17	7.02ab ± 0.10	6.58ab ± 0.18	6.54ab ± 0.12	6.64ab ± 0.14
45	4.17d ± 0.17	6.88ab ± 0.13	6.46ab ± 0.13	6.40b ± 0.16	6.46b ± 0.14
60	3.88e ± 0.14	6.72b ± 0.11	6.28b ± 0.18	6.34b ± 0.20	6.42b ± 0.13

Means followed by the same letter within each column are not significantly different ($P < 0.05$).

Similar changes in color were also observed by Wahla [18] in ready to drink communicated guava drink and in flavor by Sarhan et al. [19] thus, supporting our observations. The changes in color during storage might be due to the action of sunlight or browning caused by Millard's reaction and in flavor might be due to the destruction of flavoring compounds in the drink. The production of off-flavor in the food products was also might be attributed to the water and air born contaminations, packing materials and enzymes [20]. According to Jacob [21] the high temperature (100 °F) caused color and flavor changes as well as loss in vitamin. The changes in overall acceptability were might be due to the changes in color, flavor, and taste of the drink. Similar changes in acceptability were also reported by Sandhu and Bhatti [22] and Zia [23].

Conclusions

This study evaluated the effect of different combinations of citric acid and lactic acid on vitamin-C, color, taste, flavor and overall acceptability of ready to serve apple drink during storage period of 60 days. It was observed that vitamin-C and all the sensory parameters were adversely affected by the storage period.

The results regarding different combinations of citric acid and lactic acid showed that the treatment T_3 was the best of all concerning flavor, taste and overall acceptability of ready to serve apple drink.

On the basis of our results, further investigations are needed to assess the effect of different combinations of citric acid and lactic acid not only on the overall quality of apple juice but also the other fruit juices.

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