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Effect of citric acid on the storage stability of sugarcane juice at different temperatures

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Key words: Sugarcane, Citric acid, Pasteurization, Room temperature, Refrigeration.

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Abstract

The current study was planned to check the storage stability of the sugarcane juice. For that purpose, all the treatments were optimized based on sensory evaluation, turbidity and color attributes at different concentrations of potassium meta-bisulphite (KMS) (0, 40, 80, 120, 150, and 200 ppm), citric acid (0, 15, 30, 40, and 60 /100 ml), and pasteurization temperature (50, 70, 90 and 100°C) for 10 min of juice. Then sugarcane juice samples were formulated by adding citric acid (40 mg/100 ml), pasteurizing the juice for 10 minutes at 70°C and potassium metabisulphite (150 ppm). Pre-sterilized glass bottles were used for storing the sugarcane juice at refrigeration (4±2 °C) temperature and room (30±5 °C). Samples were tested for physiochemical (total soluble solids, total sugar, reducing sugar, acidity, pH, and viscosity), microbial test (TPC, yeast, and mold) and sensory evaluation (texture, flavor, and overall acceptability). Results indicated that the total soluble solids, pH and total sugars decreased, whereas, reducing sugars and titratable acidity increased significantly ($P<0.01$) during storage. An appreciable increase in total plate counts and yeast and mold counts were observed, however, no coliforms were detected in sugarcane juice during the storage period. The changes in different attributes were significantly ($P<0.01$) higher at room temperature as compared to refrigeration temperature. The sugarcane juice having citric acid and potassium meta-bisulphite showed minimum changes in sensory qualities during storage, both at room and refrigeration temperature.

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Introduction

Sugarcane (*Saccharum officinarum* Linn.), belonging to the Poaceae family, has been produced worldwide for economical and medicinal valued products, for example, drinking cane juice, pulp, alcohol, pesticides, xylitol, paper, feed, organic manure, and electricity (Li and Yang, 2015; Xiao *et al.,* 2017). For subtropical and tropical regions, strong growth has shown that the well-drained soils (pH 7.5–8.5), humid high organic matter, and hot conditions have been added (Koh, 2009). Glucose and fructose are present in sugarcane and they are still a low-cost energy crop (Yadav and Solomon, 2006). The presence of flavonoids, phenolic acids, and many other phenolic compounds in sugarcane allows its juices and syrup to have antioxidant activity (Payet *et al.,* 2006).

Different products such as brown sugar and molasses are obtained during processing brown sugar and jaggery are safer than white sugar (Fraser, 2012). Molasses are used for ethanol and biogas production. Due to its cosmetic and medicinal properties, sugar cane wax was a replacement for the expensive carnauba wax. Roots and stems of sugarcane are used extensively for various skin and asthma, bronchitis, heart conditions, jaundice, anemia, blood pressure urinary tract infections, and constipation (Akber *et al.,* 2011). Raw sugarcane is now a popular commercial drink for the treatment of different diseases and delicious beverages. To produce a new juice, the fresh culms of cane sugar are produced. It is highly nutritious and contains natural sugars, specific mineral products, amino acids, vitamins, phosphatides, organic acids, and starch (Nishad *et al.,* 2017). Sugar cane juice contains 40 kcal of sugar, iron 1.1 mg, 10 mg of calcium, and 6 mg of beta carotene. A minimum of 20% of the total soluble solids are in the sugarcane juice and 80% are water, water activity and pH are 0.99 and 4.6 respectively (Silva *et al.*, 2016). According to Parvathy, 1983 the sugarcane juice has been thought to help in the recovery from hemorrhage, dysuria, anuria, jaundice, cancer, cardiovascular and urinary diseases (Cáceres *et al.,* 1987; Karthikeyan and Samipillai, 2010). The sugarcane juice exhibited diuretic properties, owing to which it supports immune-stimulatory effects and urinary flow (Hikosaka *et al.,* 2007; Akram *et al.,* 2014). Thus, the consistent use of juice aids the urinary system, as well as kidneys in acting their best role. The juice is also drunk in blend with lime juice or ginger for added benefits. (Singh *et al.,* 2015).

Fresh sugarcane juice cannot usually be stored for more than six hours and has short shelf life commercially. Huge amounts of sugar combined with bit quantities of organic acids and polyphenols are responsible for the consequent dark-brown color and rapid fermentation. The activity of polyphenol oxidase leads to fermentation which makes the juice unmarketable (Qudsieh *et al.,* 2002; Özoğlu and Bayındırlı, 2002). A wide variety of techniques are used for the preservation of sugarcane juice by hot water blanching of raw materials, antimicrobial and antioxidants agents (Taylor *et al.,* 2005), heat-based inactivation of enzymes (Yusof *et al.,* 2000), gamma radiation processing (2–10 kGy) (Alcarde *et al.,* 2001), spray drying technology (Nishad *et al.,*2017), and freeze concentration and low-temperature storage (Songsermpong and Jittanit, 2010). Such methods are designed to minimize changes in quality to maximize the shelf life of sugar cane. Hence keeping in observation all of the above-stated facts, the main aims of the research was to study the effect of citric acid on the physicochemical, sensorial, and stability of the sugarcane juice.

Materials and methods

The production of sugar cane juice was obtained from fresh sugar cane. Sugar cane was then made free of any dust and dirt by running tap water. Then with the aid of a curved blade knife, the skin and sugarcane node stem was removed. A power-operated sugar cane crusher press was used for extracting sugar cane juice. The sugar cane juice collected was filtered by the muslin cloth to remove the extraction content.

Optimization of treatments

Treatments were optimized based on color attributes, sensory evaluation by 9point hedonic scale, and

turbidity (Laksameethanasana *et al.,* 2012) at different concentrations of potassium meta-bisulphite (KMS) (0, 40, 80, 120, 150, and 200 ppm), citric acid (0, 15, 30, 40, and 60 /100 ml), and pasteurization temperature (50, 70, 90 and 100°C) for 10 min of juice. Concentrations of citric acid 40 mg/100 ml, KMS 150 ppm, and pasteurization at 70C for 10 minutes were found best for the treatment of sugarcane juice.

Preservation of juice

Different lots of sugarcane juices were subjected to T0 = pasteurization (at 70°C for 10 min), T1 = pasteurization after adding citric acid (40 mg/100 ml), and T2 = pasteurization after adding citric acid followed by the addition of potassium metabisulphite (150 ppm). All the samples of juices were kept for 60 days at refrigeration temperature (4 ±2C) and room temperature (30± 5C). The samples were drawn and analyzed for microbiological, physic-chemical, and sensory attributes at an interval of 15 days.

Physico-chemical analyses

Total soluble solids: Total soluble solids were measured by the AOAC (2000) method.

Acidity: Acidity was determined by direct titration followed by method No. 947.05 (AOAC 2000).

pH: The pH was directly measured by using the pH meter (WTW series pH-720).

Viscosity: The viscosity of the sugarcane was obtained using a Brookfield DV-I viscometer (LVDVE 230) as described by (Gassem and Frank, 1991).

Total sugars: Total sugars were estimated by the method as given in AOAC (2000).

Reducing sugar: Sugarcane juice was tested for reducing the sugar by the method determined by AACC 2000 method 80-60.

Microbial analysis

Total viable count: Sugarcane juice was tested for Total Viable Count by the method determined by AACC 2000 Method 42-11.

Yeast and mold count: Sugarcane juice was tested for Yeast and mold count by the method determined by AACC 2000 Method 42-50.

Organoleptic evaluation

All the frozen sugarcane juice samples were organoleptically rated for appearance, flavor and overall acceptability by a panel of 6 judges by using a 9-point hedonic scale (Larmond 1997).

Statistical analysis

The data obtained from different parameters was statistically subjected to determine the level of significance by using SPSS version 23, Steel *et al.,* (1997).

Results and discussion

Physico-chemical analyses

TSS

Mean values regarding the TSS of sugarcane juice are given in Table 1 which indicated significant results. Results showed that the TSS of sugarcane juice at different treatment and different storage periods ranged from 18.5 to 21.2%.

The minimum value (18.5%) of TSS was found in sample to which was stored for 60th day at room temperature whilst the maximum value (21.2 %) was exhibited in T0 which was stored at refrigeration temperature for 0 days. The total soluble solids reduced significantly ($P < 0.01$) at refrigeration as well as room temperature during the storage of sugarcane juice, however, the reduction was of slighter range at refrigeration temperature. These results are in line with the observations of Chauhan, *et al.,* (2002). They credited the decline in TSS to acids throughout storage because of the act of micro-organism and other bacteria present in the juice.

Total sugar

Mean values regarding the Total sugar content of sugarcane juice are given in Table 2 which indicated

significant results. Results showed that the total sugar content of sugarcane juice at different treatment and different storage periods ranged from 17.72 to 22.1%. The minimum value (17.72 %) of total sugar content was found in sample To which was stored for 60th day at room temperature whilst the maximum value (22.1%) was exhibited in T3 which was stored at refrigeration temperature on 0th days. The total sugar content reduced significantly (P <0.01) at refrigeration as well as room temperature during the storage of sugarcane juice, however, the reduction was of slighter range at refrigeration temperature. These results are in line with the observations of Chauhan, *et al.,* (2002).

Table 1. Effect of different treatments on the TSS of sugarcane juice.

Days	0 Day (S_1)		15th Day (S_2)		30th Day (S_3)		45th day (S_4)		60th day (S_4)	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF
To	21.0±0.5	21.2±0.2	20.9±0.8	21.0±0.4	20.6±0.6	21.0±0.5	19.2±0.6	20.8±0.2	18.5±0.5	20.7±0.7
T1	21.0±0.4	21.0±0.2	21.0±0.7	21.0±0.1	20.4±0.8	20.8±0.4	19.9±0.3	20.8±0.4	19.5±0.4	20.8±0.4
T2	20.8±0.4	20.8±0.4	20.8±0.1	20.8±0.7	20.8±0.5	20.8±0.4	20.8±0.7	20.8±0.3	20.7±0.7	20.8±0.4

Treatments: A=Pasteurization, B=Pasteurization + citric acid, C=Pasteurization+citric acid+KMS

Reducing sugar

Mean values regarding the reducing sugar content of sugarcane juice are given in Table 3 which indicated significant results. Results showed that the reducing sugar content of sugarcane juice at different treatment and different storage periods ranged from 0.69 to 1.37%. The minimum value (0.69 %) of reducing sugar content was found in sample To which was stored for 0th day at refrigeration temperature as well as room temperature whilst the maximum value (1.37 %) was exhibited in To which was stored at room temperature for 60th days. All the samples To (1.28 %) showed near to maximum storage life at 45th and 60th day when samples were kept at room and refrigeration temperature respectively whereas T1 (0.71%), T2 (0.71%) was showed minimum storage life at refrigeration temperature and room temperature at 0 days respectively.

This means that reducing sugar is gradually increased during the storage and maximum on the 60th day. The reducing sugars contents in sugarcane juice increased significantly (P <0.01) throughout storage because of the hydrolysis of non-reducing sugars.

Table 2. Effect of different treatments on the total sugar of Sugarcane juice.

Days	0 Day (S_1)		15th Day (S_2)		30th Day (S_3)		45th day (S_4)		60th day (S_4)	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF
A	21.8±0.5	21.8±0.3	21.4±0.2	21.5±0.8	20.1±0.3	20.4±0.6	18.5±0.7	19.26±0.5	17.72±0.2	19.1±0.7
B	22.0±0.4	22.0±0.5	21.1±0.6	21.8±0.2	20.06±0.8	21.5±0.4	19.6±0.7	20.4±0.1	18.39±0.6	19.6±0.8
C	22±0.4	22.1±0.6	21.6±0.3	21.9±0.8	21.0±0.5	21.8±0.8	20.1±0.5	21.5±0.4	19.6±0.6	20.1±0.4

Treatments: A=Pasteurization, B=Pasteurization + citric acid, C=Pasteurization+citric acid+KMS

Acidity

Mean values regarding the acidity of sugarcane juice are given in Table 4 which indicated significant results. Results showed that the acidity of sugarcane juice at different treatment and different storage periods ranged from 0.48 to 2.1%. The minimum value (0.48 %) of acidity was found in sample To which was stored for 0th day at room temperature whilst the maximum value (2.1 %) was exhibited in T1 which was stored at refrigeration temperature for 60th days. All the samples T1 (1.96 %), and T1 (1.92 %) showed near to maximum storage life at 45th day and 60th day when samples were stored at refrigeration temperature and room temperature respectively Whereas To (0.52%)was showed minimum storage life at refrigeration temperature at 0 days

respectively. The acidity decreased whereas pH increased significantly (P <0.01) throughout the storage of sugarcane juice. By the Addition of organic acids to sugarcane juice also decreased pH and increased its acidity. The increase in acidity and reduction in pH was, however, higher when the sugarcane juice samples were kept for 60 days at room temperature. Chauhan *et al.,* (2002) also found the results inlined to my study.

Table 3. Effect of different treatments on the reducing sugar of Sugarcane juice.

Days	0 Day (S_1)		15th Day (S_2)		30th Day (S_3)		45th day (S_4)		60th day (S_4)	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF
A	0.69±0.4	0.69±0.2	0.85±0.6	0.75±0.8	0.92±0.3	0.92±0.5	1.28±0.6	1.18±0.3	1.37±0.5	1.28±0.6
B	0.71±0.6	0.71±0.1	0.81±0.7	0.78±0.5	0.98±0.9	0.87±0.3	0.99±0.5	0.91±0.6	1.20±0.1	1.18±0.5
C	0.71±0.5	0.71±0.9	0.80±0.5	0.76±0.2	0.91±0.6	0.83±0.6	0.9±0.5	0.94±0.3	1.18±0.3	1.19±0.4

Treatments: A=Pasteurization, B=Pasteurization + citric acid, C=Pasteurization+citric acid+KMS.

pH

Mean values regarding the pH of sugarcane juice are given in Table 5 which indicated significant results. Results showed that the pH of sugarcane juice at different treatment and different storage periods ranged from 2.50 to 6.47%. The high acidity (2.50 %) of pH has been found in sample T1 which was stored for 60th day at room temperature whilst the low acidity (6.47 %) was exhibited in To which was stored at refrigeration temperature on 0th days. All the samples T1 (2.95 %) showed near to highly acidic behavior at the 60th day when samples were stored at refrigeration temperature Whereas To (6.46%), and To (6.35 %) was showed low acidic behavior at refrigeration temperature at 0th and 15th day respectively when stored at refrigeration temperature.

Table 4. Effect of different treatments on the Titratable acidity of Sugarcane juice.

Days	0 Day (S_1)		15th Day (S_2)		30th Day (S_3)		45th day (S_4)		60th day (S_4)	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF
A	0.48±0.4	0.48±0.6	0.62±0.3	0.52±0.6	0.71±0.5	0.62±0.6	0.86±0.6	0.92±0.6	1.14±0.3	1.23±0.6
B	1.42±0.4	1.42±0.6	1.62±0.6	1.82±0.4	1.72±0.2	1.92±0.5	1.88±0.7	1.96±0.5	1.92±0.8	2.1±0.5
C	1.42±0.4	1.42±0.6	1.50±0.3	1.55±0.8	1.64±0.4	1.68±0.5	1.69±0.5	1.72±0.7	1.77±0.4	1.79±0.4

Treatments: A=Pasteurization, B=Pasteurization + citric acid, C=Pasteurization+citric acid+KMS

The acidity decreased whereas pH increased significantly (P <0.01) throughout the storage of sugarcane juice. By the Addition of organic acids to sugarcane juice also decreased pH and increased its acidity. The increase in acidity and reduction in pH was, however, higher when the sugarcane juice samples were kept for 45 days at room temperature. Chauhan *et al.,* (2002) also observed similar results.

Viscosity

Mean values regarding the viscosity of sugarcane juice are given in Table 6 which indicated significant results. Results showed that the viscosity of sugarcane juice at different treatment and different storage periods ranged from 4.78 to 4.83%. The high viscosity value (4.83 %) of sugarcane juice was found in sample T2 which was stored for 0th and 15th day at room temperature whilst the low viscosity value (4.76 %) was exhibited in T2 which was stored at refrigeration temperature for 60th days. In viscosity, no significant change was observed because of the addition of organic acids and storage at refrigeration temperature or room temperature. Comparable results were also found by Chauhan *et al.,* (2002).

Microbiological analyses

Total plate count (TPC)

Mean values regarding the TPC of sugarcane juice are

given in Table 7 which indicated significant results. Results showed that the TPC of sugarcane juice at different treatments and different storage periods ranged from 2.3×10^6 to 4.3×10^6 CFU/g.

The minimum value (2.3×10^6) of total plate count has been found in sample T2 which was stored for 0th day at refrigeration temperature whilst the maximum value (4.3×10^6) was exhibited in To which was stored at room temperature for 60th days. All the samples To (3.96×10^6 CFU/g), and To (3.92×10^6 CFU/g) showed near to maximum total plate counts on the 60th and 45th day when sugarcane juice samples were kept at refrigeration and room temperature respectively Whereas T2 (2.32×10^6) was showed minimum total plate count at room temperature at 0 days.

Table 5. Effect of different treatments on the pH of sugarcane juice.

Days	0 Day (S_1)		15th Day (S_2)		30th Day (S_3)		45th day (S_4)		60th day (S_4)	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF
A	6.47±0.3	6.46±0.5	5.93±0.7	6.35±0.2	5.53±0.3	6.26±0.4	4.95±0.7	6.08±0.9	4.41±0.3	5.72±0.3
B	5.95±0.3	5.96±0.5	5.50±0.2	5.80±0.5	5.13±0.6	5.52±0.7	4.82±0.2	3.24±0.5	2.50±0.7	2.95±0.5
C	5.9±0.4	5.91±0.5	5.8±0.6	5.88±0.6	5.65±0.7	5.76±0.3	5.38±0.6	5.65±0.3	5.04±0.5	5.5±0.6

Treatments: A=Pasteurization, B=Pasteurization + citric acid, C=Pasteurization+citric acid+KMS

This means that the total plate count is gradually increased during the refrigeration temperature and room temperature. The degree of decrease in the microbial population was also lower at refrigeration as compared to room temperature. The highest total plate counts were found during the storage of controlled samples which are pasteurized juice after that an addition of citric acid.

Table 6. Effect of different treatments on the viscosity of sugarcane juice.

Days	0 Day (S_1)		15th Day (S_2)		30th Day (S_3)		45th day (S_4)		60th day (S_4)	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF
A	4.82±0.5	4.80±0.5	4.81±0.5	4.81±0.6	4.81±0.4	4.81±0.6	4.80±0.6	4.81±0.3	4.78±0.8	4.80±0.4
B	4.82±0.5	4.82±0.7	4.81±0.3	4.82±0.6	4.80±0.5	4.82±0.4	4.80±0.8	4.82±0.2	4.80±0.7	4.80±0.4
C	4.83±0.3	4.82±0.5	4.83±0.5	4.82±0.2	4.82±0.6	4.80±0.8	4.80±0.3	4.81±0.1	4.80±0.4	4.76±0.5

Treatments: A = Pasteurization, B = Pasteurization + citric acid, C = Pasteurization+citric acid+KMS

Yeast and mold

Mean values regarding the yeast and mold count of sugarcane juice are given in Table 8 which indicated significant results. Results showed that the yeast and mold count of sugarcane juice at different treatment and different storage periods ranged from 0.56 to 2.21 CFU/g. The minimum value (0.56 CFU/g) of yeast and mold count has been found in sample T2 which was stored for 0th day whilst the maximum value (2.21 CFU/g) was exhibited in To which was stored at room temperature at 60th days. All the samples To (1.98 CFU/g) showed near to maximum yeast and mold count on 60th day when sugarcane juice samples were stored at refrigeration temperature Whereas T1 (0.60 CFU/g), T1 (0.62 CFU/g) was showed minimum yeast and mold count at room temperature, and refrigeration temperature at 0 days respectively. This means that yeast and mold count is gradually increased during the refrigeration temperature room temperature for 0 days.

The extent of decrease in the microbial population was also lower at refrigeration temperature as compared to room temperature.

Sensory evaluation

Appearance

Mean values regarding the appearance of sugarcane juice are given in Table 9 which indicated significant results. Results showed that the appearance of sugarcane juice at different treatment and different storage periods ranged from 5.8 to 9.1.

Table 7. Effect of different treatments on the TPC (×10⁶) of sugarcane juice.

Days	0 Day (S_1)		15th Day (S_2)		30th Day (S_3)		45th day (S_4)		60th day (S_4)	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF
A	2.65±0.5	2.65±0.7	3.25±0.4	3.08±0.5	3.53±0.4	3.45±0.4	3.92±0.5	3.66±0.5	4.30±0.5	3.96±0.6
B	2.48±0.65	2.48±0.6	2.85±0.8	2.65±0.5	3.03±0.5	3.06±0.1	3.34±0.6	3.49±0.7	3.68±0.5	3.73±0.9
C	2.32±0.3	2.30±0.4	2.70±0.1	2.45±0.6	2.86±0.9	2.76±0.6	3.02±0.9	2.96±0.2	3.49±0.5	3.30±0.8

Treatments: A=Pasteurization, B=Pasteurization + citric acid, C=Pasteurization+citric acid+KMS

The minimum value (5.8) of the appearance of sugarcane juice was found in sample To which was stored for 60th day at room temperature whilst the maximum value (9.1) was exhibited in T2 which was stored in refrigeration temperature at 45th days. All the samples T2 (8.9), T2 (8.9) showed near to maximum appearance at 45th and 60th days when samples were kept at room and refrigeration temperature respectively whereas To (6.0), and To (6.2) were showed minimum appearance at refrigeration temperature at 45th day and 60th day respectively. This means that the appearance of sugarcane juice is gradually decreased during the storage and minimum of the 45th day.

The sensory scores decreased significantly (P <0.01) as the storage period increasing. However, the increase in sensory scores (appearance) of samples kept at refrigeration temperature was significantly (P <0.01) better magnitude than those kept at room temperature. Similar results are mentioned by Chauhan *et al.,* (2002).

Table 8. Effect of different treatments on the yeast and mold of sugarcane juice.

Days	0 Day (S_1)		15th Day (S_2)		30th Day (S_3)		45th day (S_4)		60th day (S_4)	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF
A	0.65±0.5	0.65±0.3`	0.91±0.6	0.82±0.2	1.37±0.5	1.20±0.6	1.85±0.2	1.61±0.7	2.21±0.3	1.98±0.6
B	0.60±0.5	0.62±0.4	0.80±0.5	0.78±0.8	1.22±0.5	1.18±0.4	1.40±0.6	1.42±0.8	1.79±0.7	1.68±0.4
C	0.56±0.4	0.56±0.5	0.69±0.4	0.68±0.7	0.93±0.4	0.99±0.5	1.21±0.6	1.24±0.7	1.58±0.4	1.60 ±0.3

Treatments: A = Pasteurization, B = Pasteurization + citric acid, C = Pasteurization+citric acid+KMS

Flavor

Mean values regarding the flavor of sugarcane juice are given in Table 10 which indicated significant results. Results showed that the flavor of sugarcane juice at different treatment and different storage periods ranged from 5.1 to 7.5. The minimum value (5.1) of the flavor of sugarcane juice was found in sample To which was stored for 60th day at refrigeration temperature whilst the maximum value (7.5) was exhibited in T1 which was stored for 0 days. This means that the flavor of sugarcane juice is gradually decreased during the storage and minimum of the 60th day. The sensory scores decreased significantly (P <0.01) as the storage period increasing. However, the increase in sensory scores (flavor) of samples kept at refrigeration temperature was significantly (P <0.01) better magnitude than those kept at room temperature. Similar results are mentioned by Chauhan *et al.,* (2002).

Table 9. Effect of different treatments on the appearance of Sugarcane juice.

Days	0 Day (S_1)		15th Day (S_2)		30th Day (S_3)		45th day (S_4)		60th day (S_4)	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF
A	7.0±0.4	7.0±0.2	6.8±0.5	7.0±0.6	6.4±0.3	6.8±0.7	6.0±0.8	6.5±0.9	5.8±0.2	6.2±0.5
B	7.3±0.4	7.3±0.5	7.2±0.7	7.3±0.6	7.0±0.6	7.7±0.3	7.3±0.8	7.3±0.5	7.2±0.3	7.3±0.6
C	7.5±0.3	7.5±0.5	7.3±0.6	7.5±0.5	7.1±0.6	7.4±0.8	8.9±0.6	9.1±0.2	8.5±0.5	8.9±0.5

Treatments: A=Pasteurization, B=Pasteurization + citric acid, C=Pasteurization+citric acid+KMS

Overall acceptability

Mean values regarding the overall acceptability of sugarcane juice are given in Table 11 which indicated significant results. Results showed that the overall acceptability of sugarcane juice at different treatment and different storage periods ranged from 6.0 to 8.7. The minimum overall acceptability value (6.0) of sugarcane juice was found in sample To which was stored for 60th day at room temperature whilst the maximum overall acceptability value (8.7) was exhibited in T1 which was stored at room temperature on 0th days. This means that the flavor of sugarcane juice is gradually decreased during the storage and minimum of the 60th day.

Table 10. Effect of different treatments on the flavor of sugarcane juice.

Days	0 Day (S_1)		15th Day (S_2)		30th Day (S_3)		45th day (S_4)		60th day (S_4)	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF
A	7.0±0.6	7.0±0.5	6.8±0.4	6.9±0.2	6.2±0.5	6.5±0.9	5.3±0.3	5.8±0.5	5.2±0.5	5.1±0.4
B	7.5±0.4	7.5±0.6	7.1±0.3	7.5±0.6	6.8±0.6	7.1±0.8	6.0±0.2	6.6±0.6	5.1±0.5	6.0±0.2
C	7.3±0.2	7.3±0.4	7.2±0.4	7.3±0.3	7.0±0.6	7.2±0.7	6.5±0.8	6.9±0.9	5.9±0.3	6.3±0.5

Treatments: A=Pasteurization, B=Pasteurization + citric acid, C=Pasteurization+citric acid+KMS

Table 11. Effect of different treatments on the Overall acceptability of Sugarcane juice.

Days	0 Day (S_1)		15th Day (S_2)		30th Day (S_3)		45th day (S_4)		60th day (S_4)	
Treatments	R	RF	R	RF	R	RF	R	RF	R	RF
A	8.6±0.4	8.6±0.5	8.2±0.6	8.4±0.6	7.5±0.2	7.9±0.7	7.0±0.9	7.3±0.4	6.0±0.7	6.7±0.4
B	8.7±0.4	8.6±0.6	8.3±0.4	8.4±0.6	7.5±0.4	7.6±0.6	7.1±0.7	7.0±0.4	6.5±0.6	6.6±0.7
C	8.2±0.5	8.2±0.5	8.1±0.6	8.1±0.4	7.6±0.5	7.5±0.6	7.1±0.7	7.3±0.4	6.5±0.5	6.6±0.5

Treatments: A=Pasteurization, B=Pasteurization + citric acid, C=Pasteurization +citric acid +KMS

The sensory scores decreased significantly (P <0.01) as the storage period increasing. However, the increase in sensory scores (flavor) of samples kept at refrigeration temperature was significantly (P <0.01) better magnitude than those kept at room temperature. Similar results are mentioned by Chauhan *et al.,* (2002).

Conclusion

Based on the facts stated above, it can be inferred that citric acid was able to reduce the pH of sugarcane juice to 4.9, which produced a preservative effect and prevented the growth of micro-organisms during storage. Often used for the preservation of foods, Potassium metabisulphite is a yeast and mold inhibitor. The sugarcane juice having citric acid and potassium metabisulphite showed minimum changes in sensory qualities during storage, both at room and refrigeration temperature.

Therefore, it was concluded that an acceptable quality beverage of sugarcane with satisfactory storage stability of up to 60 days at the room as well as refrigeration temperature could be prepared.

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