



Research Article

Study on the nutritional and microbiological changes of sugarcane juice and determination of optimum conditions during pasteurization

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Abstract

Sugarcane juice is a popular drink in India but in most cases it is not available in hygienic condition. Attempts were made to study the effect of temperature on the rates of decomposition of Vitamin-C and destruction of microorganisms in sugarcane juice during pasteurization, followed by packaging in flexible packs. Pasteurization of 30 conical flasks which contained 100 ml of sugarcane juice per flask at different temperatures, 80°C, 85°C and 90°C for different time intervals; 30 seconds, 1 minute, 2 minutes and 5 minutes for the estimation of Vitamin-C and microbial count while keeping the flasks under two different conditions such as refrigerated temperature (4°C) and room temperature (30°C). Another set of experiments were carried out by adding sodium metabisulphite (preservative) at two concentrations; 500 ppm and 1000 ppm. Initially the quality of sugarcane juice with respect to Vitamin-C and microbial count were evaluated. Similarly the quality of the processed sugarcane juice was also evaluated. Proximate analyses such as taste, smell and colour were also undertaken. The best result with respect to Vitamin-C retention and reduction of microbial load was obtained from the juice which was pasteurized at 90°C for 5 minutes and stored at refrigerated temperature (4°C). After 25 days the vitamin-C content was found to be 4.7 mg/ml and microbial count was found to be 50/1ml in comparison to the values of the original sample.

Keywords: beverages, preservative, vitamin-C, microbial count, India.

Introduction

Sugarcane juice is a very popular drink in India but still it is rarely available commercially in packaged form. It is available from the local vendors but not available in all seasons. Sugarcane contains about 70% water [1], in which sucrose and other substances are held in solution, forming about 88% by weight of juice in the stem. The remaining 12% represents the insoluble cane fibre component [2].

The juice is extracted from the cane by pressing it through iron rollers. It is nutritious and refreshing. It contains about 15% natural sugar and is rich in organic salts and vitamins. It strengthens the stomach, kidneys, heart, eyes, sex organs and brain [3, 4]. Sugarcane is very useful in scanty urination. It keeps the urinary flow clear and helps the kidneys to perform their functions properly. Mixed with lime juice, it can hasten recovery from jaundice [5].

In most cases sugarcane juice is not available in hygienic condition. At room temperature sugarcane juice contains mainly mesophilic bacteria. At refrigerated condition the growth is possible mainly due to psychrophilic bacteria [6]. Attempts have been made to study the effect of temperature on the rates of decomposition of vitamin-C and destruction of microorganisms of sugarcane juice during pasteurization followed by packaging in flexible packs. When heated at a higher temperature a major portion of the microbes that are present at room temperature and refrigerated temperature died, however, the thermophilic microbes grew. This is why abrupt cooling of the juice at room temperature and storage under refrigerated conditions inactivates a majority of thermophilic bacteria [7].

Materials and Methods

Sugarcane juice was first collected from a local vendor and its nutritional quality, mainly vitamin-C [8] and microbial count [9] were measured by standard methods.

Heat treatment

Thirty conical flasks (250 ml, Borosil) were used. 100ml of sugarcane juice was poured into each flask. The flasks were then divided into 7 sets. The sets of juice were pasteurized at 3 different temperatures (80, 85 and 90°C) with time intervals of 30 seconds, 1 minute, 2 minutes and 5 minutes. The juice was pasteurized in sets, such as Set-1 and Set-2 (80°C-30 seconds, 80°C-1 minute, 80°C-2 minutes, 80°C-5 minutes), Set-3 and Set-4 (85°C-30 seconds, 85°C-1 minute, 85°C-2 minutes, 85°C-5 minutes), Set-5 and Set-6 (90°C-30 seconds, 90°C-1 minute, 90°C-2 minutes, 90°C-5 minutes).

Sets 1, 3 and 5 were stored under room temperature while Sets 2, 4 and 6 were stored under refrigerated temperature. Vitamin C and microbial count were taken every 2-3 days.

Chemical preservative treatment

In another set (Set-7) of juice, chemical preservative (sodium metabisulphite) was added into 2 different concentrations, 500 ppm (500 mg/1000ml) (2 flasks) and 1000 ppm (1000 mg/ 1000ml) (2 flasks). The conical flasks were kept under room temperature. Vitamin C and microbial count were taken every two or three days.

Measurement of vitamin-C content

The 2, 6-dichlorophenolindophenol method was used to assay vitamin C content in juice by spectrofluorometer. A wavelength of 350–430 nm was used to determine total vitamin C content [8]. For the measurement of vitamin-C content, reagents used were 5% metaphosphoric acid solutions, ascorbic acid standard solution, 0.025% 2, 6-dichlorophenol indophenol reagent.

Measurement of microbial content

Serial dilution and plating method [9] was used for estimation of microbial content. Nutrient agar media was chosen for the growth media. Materials for nutrient agar media were beef extract, peptone, agar and distilled water.

Observed Physical Changes in the Juice

Colour

The colour of the sugarcane juice was light lemonish yellow. In the case of room temperature storage, heating fades the colour with time and attains a light whitish homogenous turbid solution at the end of the week. In case of refrigerated storage and preservative storage after heating this fading of colour is comparatively slower.

Smell

The smell of the sugarcane juice was like sugar and change of smell through days was negligible.

Results and Discussion

Vitamin-C-time interval

Strength of Vitamin-C decreases with time. In the case of room temperature it was decreasing with time. In the case of refrigerated sample it was decreasing more slowly than room temperature. In the case of preservative it was also found to be decreasing. From Figure 1 and Figure 3 it is evident that the juice with Vitamin-C at 80°C and 85°C respectively, preserved at room temperature was found to be decreasing but in case of refrigerated temperature Vitamin-C was slowly decreasing. Figure 5 shows that the juice with Vitamin-C at 90°C when preserved at room temperature and at refrigerated temperature Vitamin-C was not decreasing. Figure 7 shows that the juice stored with preservative at 1000 ppm, a favourable curve and better storage quality was obtained.

Microbial count-time interval

Microbial count of the juice rises with time. In some cases it was increasing rapidly such as in the case of room temperature and preservative storage but in some other cases it was slowly increasing such as in refrigerated storage. From Figure 2 and Figure 4 it is evident that the juice with microbial count at 80°C and 85°C respectively, when preserved at room temperature the count was increasing but in the case of refrigerated temperature it was slowly increasing. In Figure 6 the juice with microbial count at 90°C preserved at room temperature was found to be slightly increasing and that of the refrigerated sample was not changing and it was 1/10 times lesser than 80°C and 85°C. Figure 8 shows that the juice stored with preservative at 1000 ppm, a favourable curve and better storage quality was obtained.

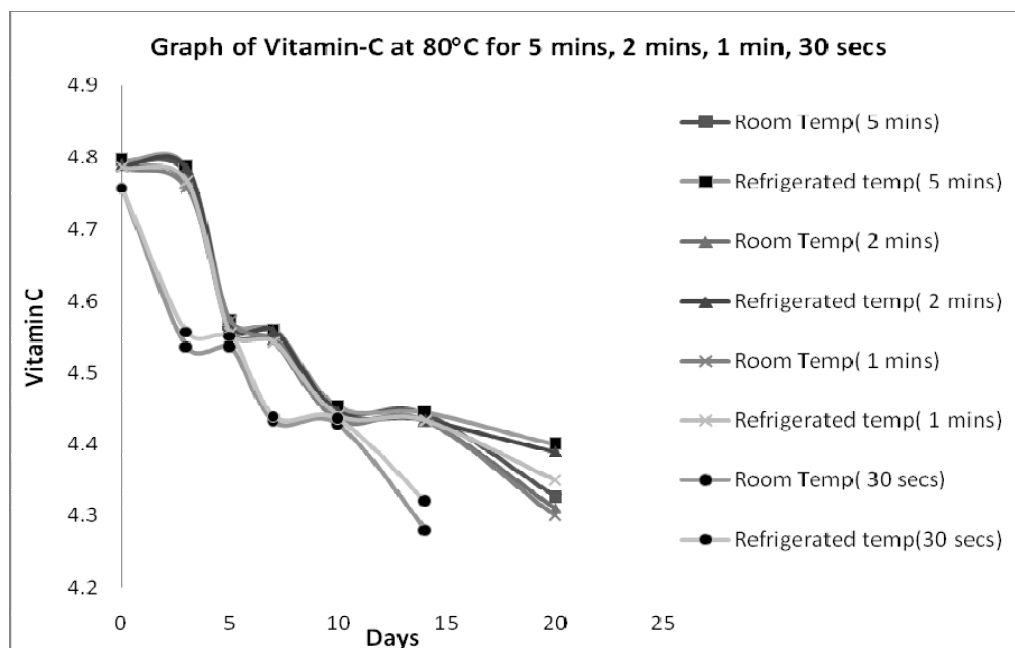


Figure 1. Graph of Vitamin-C of sugarcane juice pasteurized at 80°C for 5 minutes, 2 minutes, 1 minute, 30 seconds and stored at room temperature and refrigerated temperature.

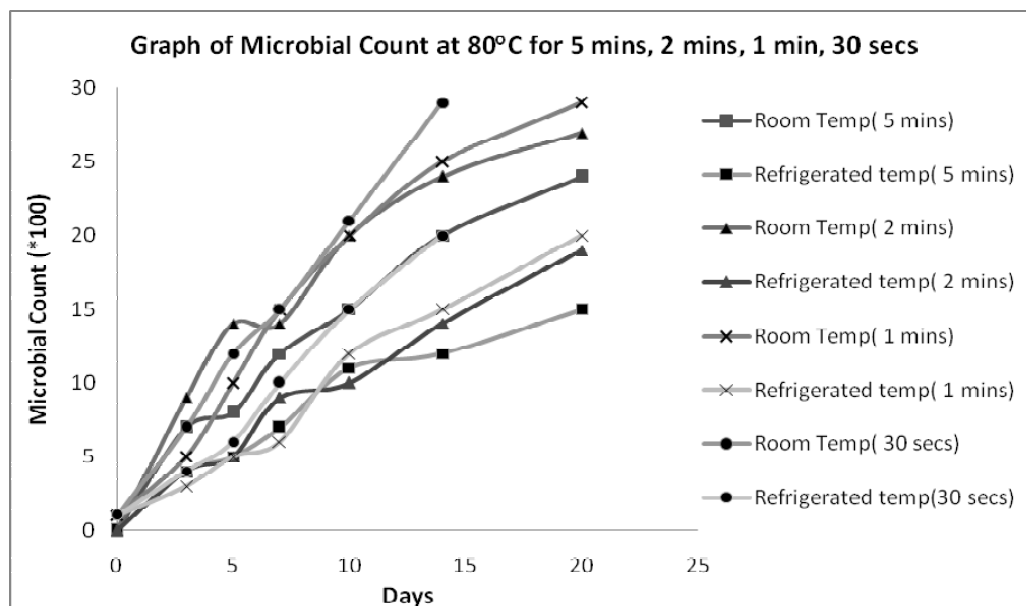


Figure 2. Graph of Microbial Count of sugarcane juice pasteurized at 80°C for 5 minutes, 2 minutes, 1 minute, 30 seconds and stored at room temperature and refrigerated temperature.

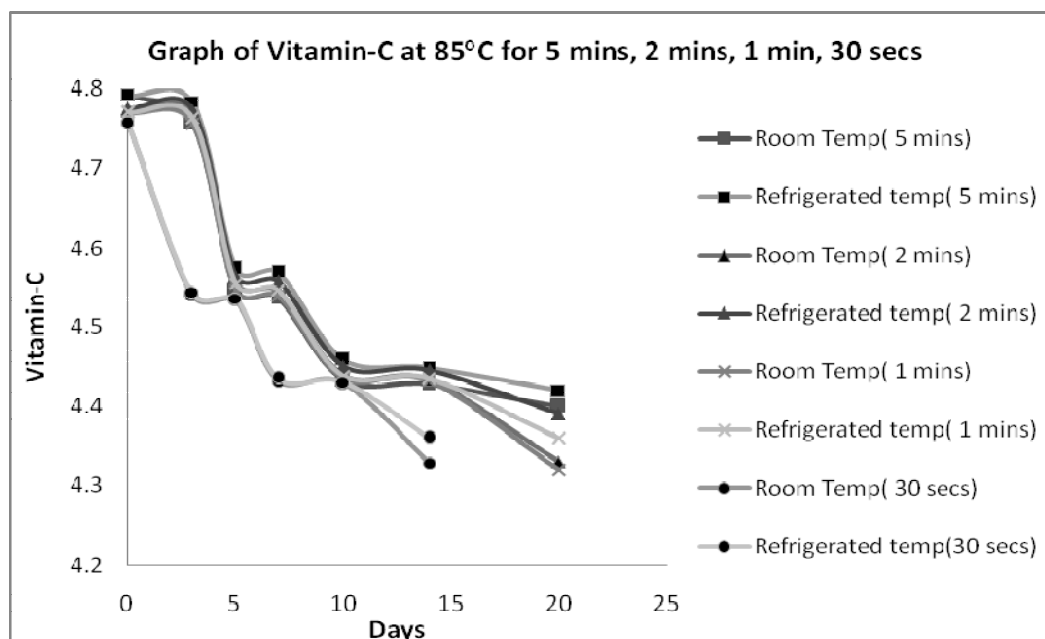


Figure 3. Graph of Vitamin-C of sugarcane juice pasteurized at 85°C for 5 minutes, 2 minutes, 1 minute, 30 seconds and stored at room temperature and refrigerated temperature.

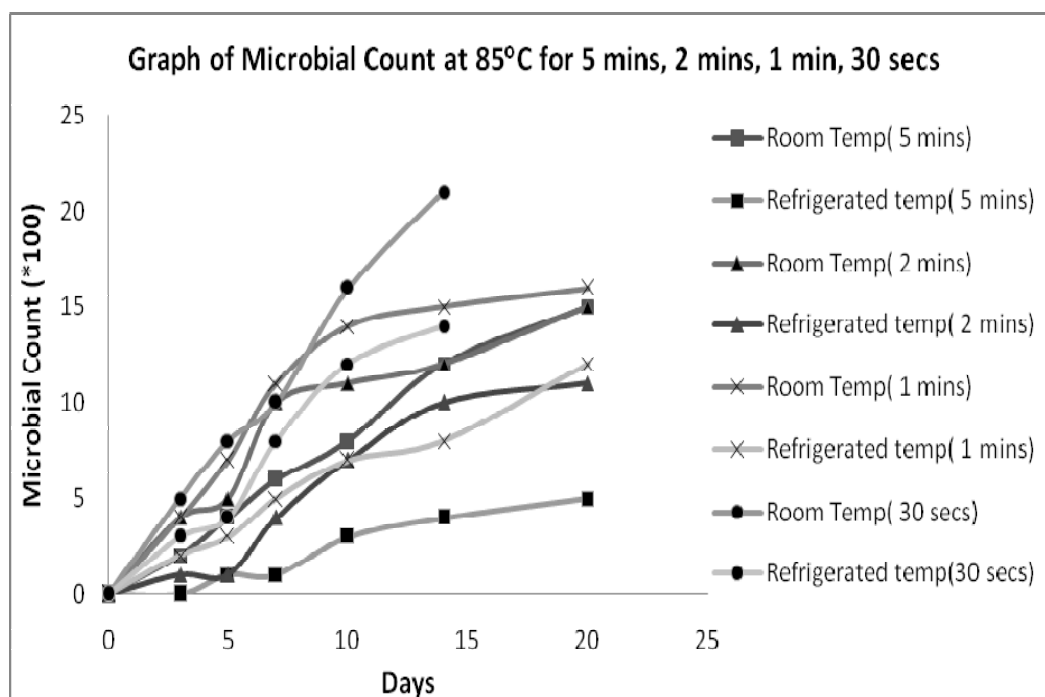


Figure 4. Graph of Microbial Count of sugarcane juice pasteurized at 85°C for 5 minutes, 2 minutes, 1 minute, 30 seconds and stored at room temperature and refrigerated temperature.

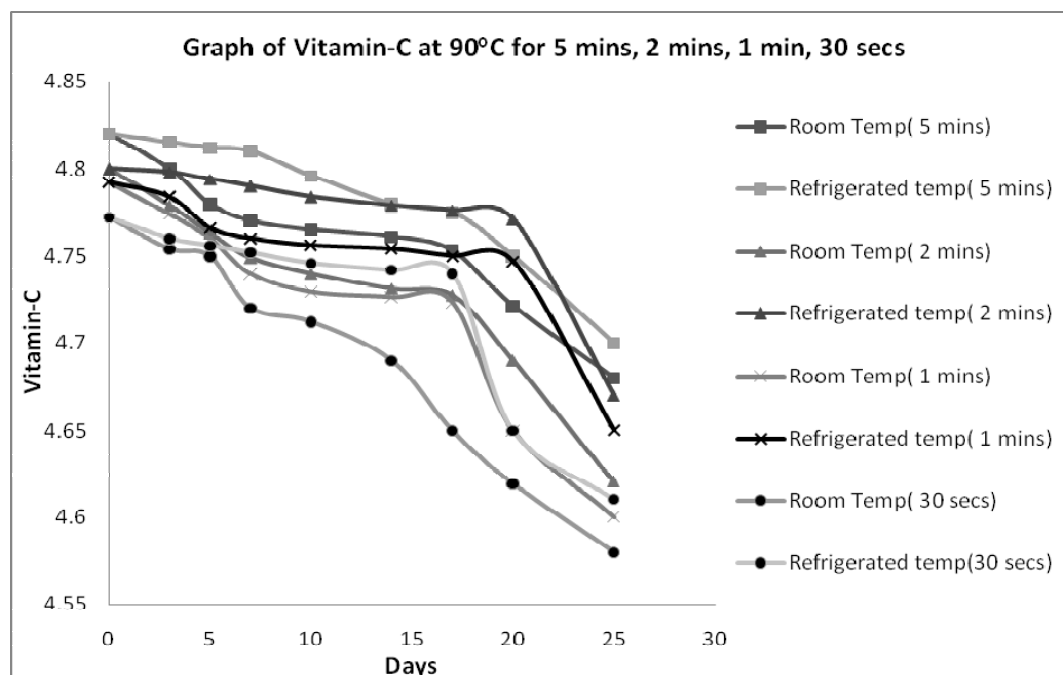


Figure 5. Graph of Vitamin-C of sugarcane juice pasteurized at 90°C for 5 minutes, 2 minutes, 1 minute, 30 seconds and stored at room temperature and refrigerated temperature.

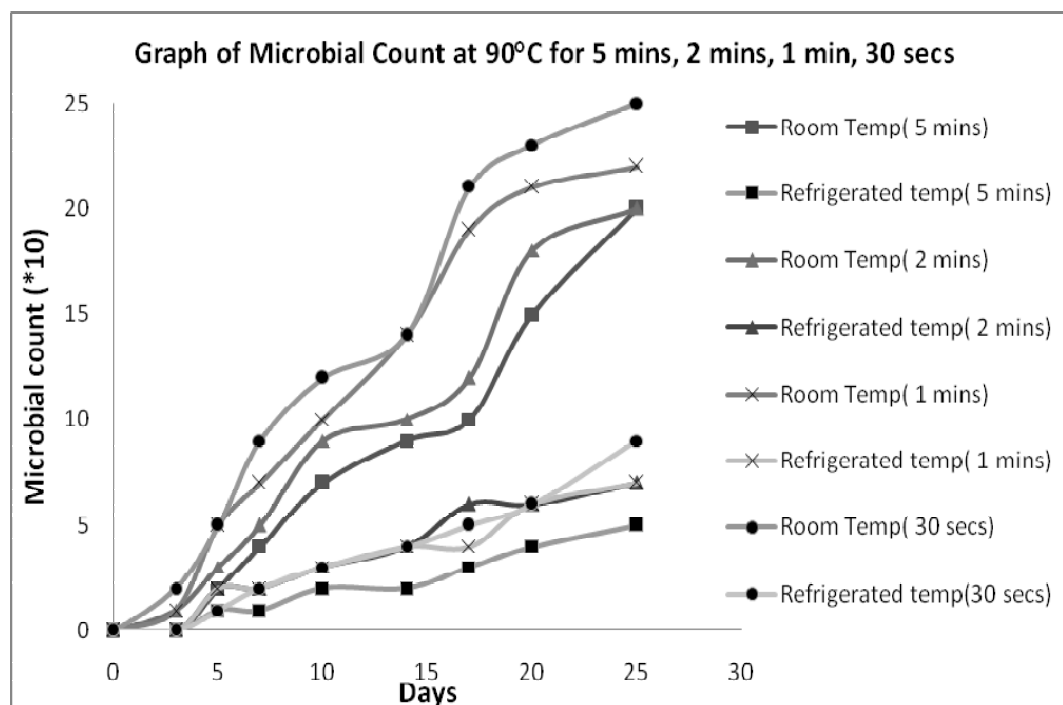


Figure 6: Graph of Microbial Count of sugarcane juice pasteurized at 90°C for 5 minutes, 2 minutes, 1 minute, 30 seconds and stored at room temperature and refrigerated temperature.

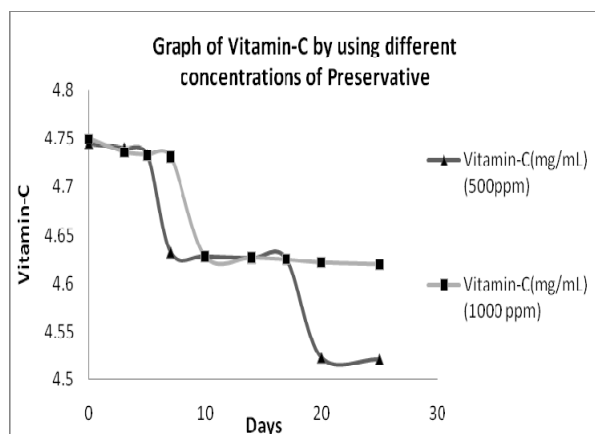


Figure 7. Graph of Vitamin-C by using different concentrations of preservative.

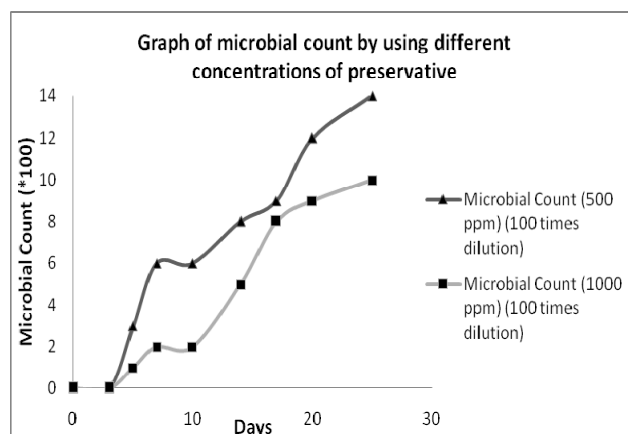


Figure 8. Graph of Microbial Count by using different concentrations of preservative.

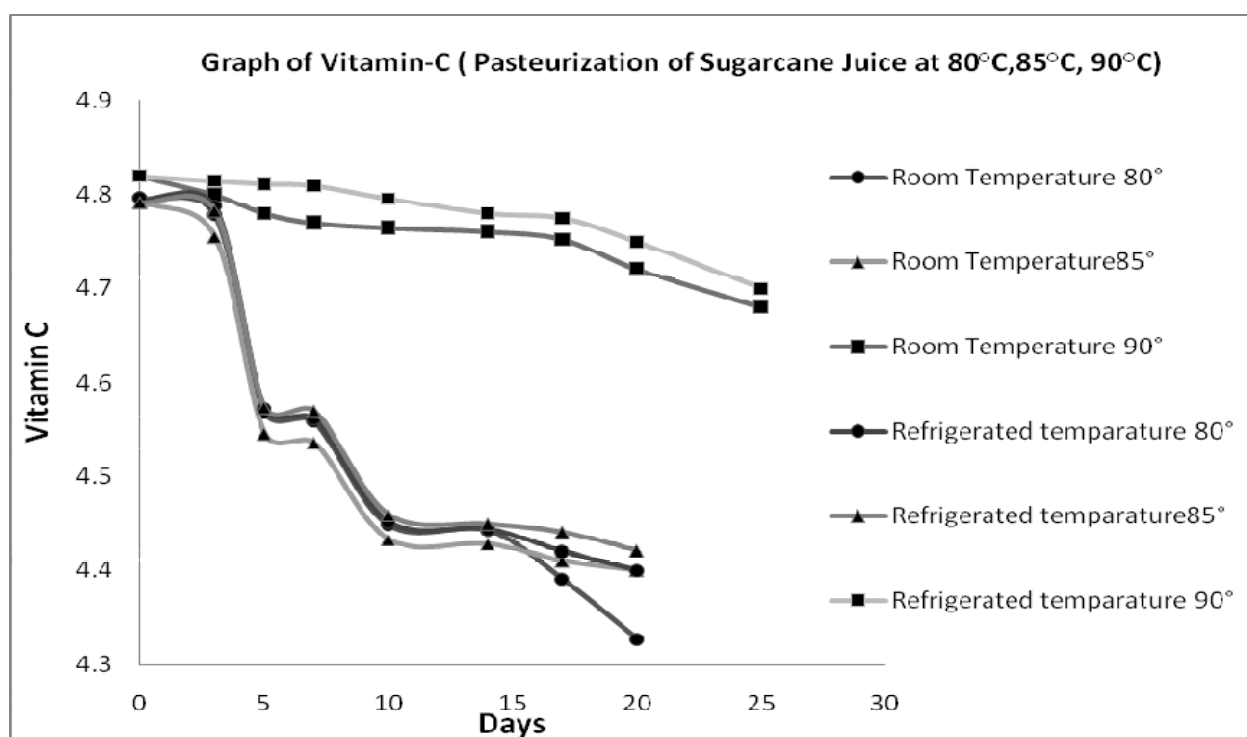


Figure 9. Graph of Vitamin-C of sugarcane juice pasteurized for 5 minutes at 80°C, 85°C, 90°C and stored at room temperature and refrigerated temperature.

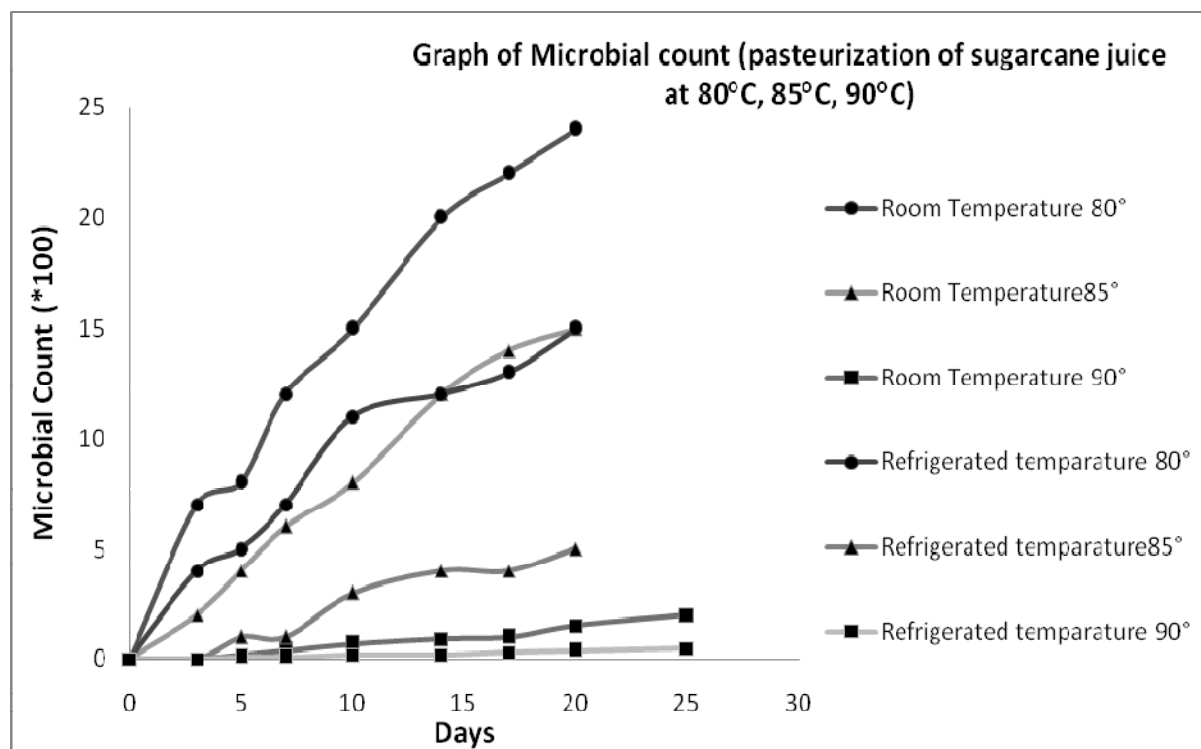


Figure 10. Graph of Microbial Count of sugarcane juice pasteurized for 5 minutes at 80°C, 85°C, 90°C and stored at room temperature and refrigerated temperature.

Conclusion

Following the kinetic study, it can be discussed that for each treatment two different studies were made on the basis of above mentioned properties. It was found that in refrigerated condition these properties remain intact for a longer time. After studying all the parameters of the sugarcane juice in each of the above mentioned conditions, the most favourable curve and better storage quality was obtained in the case of heating at 90°C for 5 minutes and storing at refrigerated temperature. Also for the juice stored with preservatives of 1000 ppm, a favourable curve and better storage quality was obtained.

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References

1. Fortin, Francois, Editorial Director (1996). The Visual Foods Encyclopedia. Macmillan, New York.
2. Wood, Rebecca (1988). The Whole Foods Encyclopedia. New York, NY: Prentice-Hall Press; PMID:15220

3. Ensminger, A.H., Ensminger, M.E., Kondale, J.E. and Robson, J.R.K. (1983). Foods and Nutrition Encyclopedia. Pegus Press, Clovis, California.
4. Ensminger, A.H. and Ensminger, M.E. (1986). Food for Health: A Nutrition Encyclopedia. Clovis, California: Pegus Press; PMID:15210.
5. Pat (2008). *Diet, Healthy Nutrition and Exercise Guide for Better Health: SugarCane Juice And Treatment For Jaundice Bilirubin Levels.*
6. Morita, Richard Y. (1975). Bacteriological Reviews: Psychrophilic Bacteria p.144-167
7. Cummins, C.S. and Johnson, J.L. (1986). Genus I. *Propionibacterium* Orla-Jensen 1909. Pages 1346-1353 in Bergey's Manual of Systematic Bacteriology. P.H.A. Sneath, N.S. Mair, M.E. Sharpe, and J.G. Holt, ed , Baltimore.
8. AOAC (1995). Vitamin-C (total) in vitamin preparations. Official methods of analysis (Vol. 2, p.967.22).
9. Collins, C.H. (1967). Microbiological methods. Plenum Press, New York.