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RESEARCH ARTICLE

STUDIES ON DEVELOPMENT OF NON-ALCOHOLIC BEVERAGE FROM GRAPES

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ABSTRACT

Ready-to-serve beverage of grapes are a product with severe shelf life problems. Alcoholic fermentation, Quality loss, color changes and mould contamination are greatly influenced the quality of grape beverage. Limiting or preventing the growth of undesirable microbial flora in grape juice for the inhibition of alcoholic fermentation is one of the main goal of preservation. The present work was to investigate the effects of preservatives such as sodium benzoate, potassium meta bisulphite and combination of both (potassium meta bisulphite + sodium benzoate) in grape juice preservation. Initially various pulp concentration (8%, 10%, 12%, 14%,16%) of grape juice was taken and preserved with sodium benzoate of 140mg/l. Then sugar content was optimized to 15ºBrix and preservatives of sodium benzoate (140mg/L), potassium metabisulphite (120mg/L) and combination of both 60mg/L + 60mg/L) were used for preservation and storage studies were conducted. The Organoleptic studies of preserved grape juice such as alcohol estimation indicates that sodium benzoate alone and combination of sodium benzoate and potassium meta bisulphte showed significant preservation effect in grape juice. This study nuances the application of the above mentioned.

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INTRODUCTION

Fruits and vegetables are important constituents of the diet and provide significant quantities of nutrients, especially vitamins, sugars, minerals and fiber. Daily consumption of fruits and vegetables reduce the risk of cancer, heart disease, premature aging, stress and fatigue primarily due to the integrated action of oxygen radical scavengers such as β- carotene and ascorbic acid plus calcium and dietary fiber (Sindumathi *et al.,* 2013). Due to the perishable nature of the fruits and vegetables they require immediate processing to avoid post harvest losses (20-25%). Fruit beverages have higher nutritional, medicinal and calorific values compared to synthetic beverages. Therefore, fruit juices for the preparation of ready-to-serve beverage may be a convenient alternative for the utilization of fruits. It has been reported that the organoleptic quality of RTS beverage prepared from juice could be increased by the addition of spice extracts of ginger, black pepper, mint, cardamom and cumin etc (Sindumathi *et al.,*2013). Grape is one of the most popularly produced and globally well-known fruit crop (Fatih Sen *et al.,* 2014). It was reported that consumption of grape products at moderate level helps in prevention of aging related diseases (Iriti *et al.*, 2009). Microbial contamination affects quality of grape juice (Rajashekhara *et al*., 2000).

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However, yeast contamination of grape juice may occur and may lead to fermentation.Fermentation pathways start with glucose, this is because it is the simplest molecule, requiring the fewest catalytic steps, to enter into a pathway of glycolysis and central metabolism. Thus the pathway is operated by micro organisms to produce ethanol and CO_2.Thus beverages were preserved using 70 ppm SO_2, 120 ppm sodium benzoate, and pasteurization at 85°C for 15 min (Jain *et al*., 1970). Nutritional or phytochemical properties can be improved by blending which offers to adjust sugar/acid ratios and compensate undesirable juice consistency. Juices with pH 3.5 adjusted using organic acids (citric, malic and tartaric acids at 0.15% each and lactic acid at 0.1%) and preservatives (Sodium benzoate and Potassium sorbate at 0.1% each and combination of both at 0.05%) can be used. TSS, pH, acidity, reducing sugar, total sugar, ascorbic acid and ß-carotene was measured by standard method (Rajashekara *et al*., 1998).

MATERIALS AND METHODS

Grapes was purchased from a local market. Sugar, Sodium benzoate, Potassium meta bisulphite, Citric acid were purchased from local chemical stores. Ethanol, NaOH, phenolphthalein solution, Potassium dichromate, conc. H_2SO_4, sodium sulphite, sodium potassium tartarate, phenol were purchased from sigma Aldrich.

Production process of grape Juice

Cleaning is the first step in fruit juice manufacturing because fermentation is better controlled and it prevents post decay of grapes. Unwanted inorganic materials (soil, stones, or metallic pieces) are eliminated by putting the grapes in a water bath or by manual selection and removal of rotten bunches. The last step was dipped in a 50% ethanol to reduce the microbial load on the berries. After cleaning, grapes are crushed to facilitate juice extraction during the pressing step (Hui *et al*., 2006). Flowchart for the preparation of grape RTS beverages is represented in Figure 1.

Organoleptic Studies of Grape rts Beverage

Initially grape juice of various pulp concentration was estimated for alcohol content. For 10 days of storage period pH, ºBrix values was also estimated.

Optimized Grape Juice

The sugar content optimized to 15ºBrix, its physico-chemical analysis was done such as estimation of TSS, pH, titrable acidity, ºBrix, total sugars, reducing sugars and also its alcohol content. The pH of the periodic samples was determined by using Digital pH meter. Total soluble solids (TSS) in juice were determined by using Erma hand refractometer of 0-32 ºBrix. Titrable acidity was expressed as per cent acidity and analyzed (Amerine *et al.,* 1967). Reducing sugars were estimated by DNSA method (Miller *et al.,* 1950). Total sugars were estimated by phenol-sulphuric acid method (Dubois *et al.,* 1956) using glucose as standard. Percent of ethanol in alcoholic samples was estimated by spectrophotometer at 600 nm (Caputi *et al*., 1968).

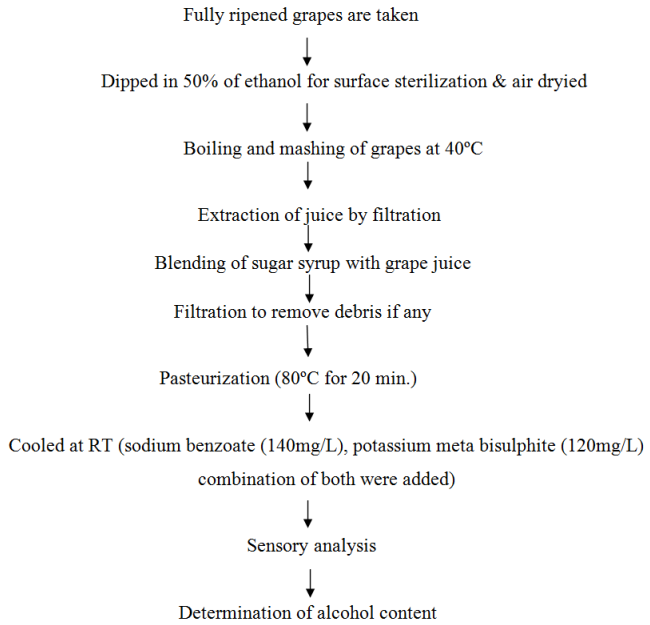

Figure 1. Flowchart for the preparation of grape RTS beverages

RESULTS AND DISCUSSION

Organoleptic Studies of Grape rts Beverage

Color Change: Fresh juice of 10 mL, which was added by 140mg /L concentration of Sodium Metabisulphate lead to color changes from pink to yellow. Thus the fruit juice color was changed.The color changes was by anthocyanin content and its structural block by SO_2.

Physico-chemical analysis of different pulp concentration of grape juice

The pH level of the grape juice was observed after 10 days of storage with different pulp concentration along with the control sample. Decrease in pH level indicated that the acidity increased in both control and treated samples. As shown in Figure 3.the decrease in ºBrix of sample and its corresponding control sample as 14ºBrix and 13ºBrix, repectively. Thus, the decrease in ºBrix levels lead to fermentation. Figure 4 , it is significant that there was a difference in the alcohol content in the grape juice in both treated and control sample. The micro-organisms in the control samples lead to alcoholic fermentation in grape juice, which led to increase in alcohol level in the controlled sample. Whereas, the juice which has undergone treatment has lo alcohol level, which is the requirement for the grape juice.

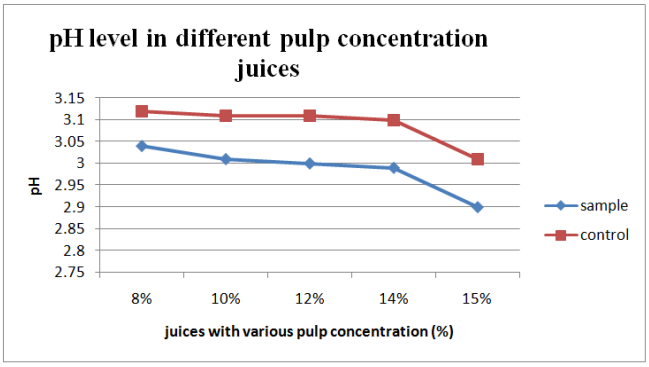

Figure 2. pH level in different pulp concentration of grape juice

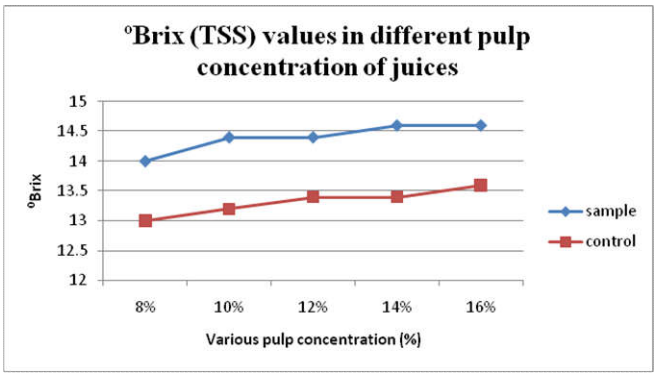

Figure 3. Brix level in different pulp concentration of grape juice

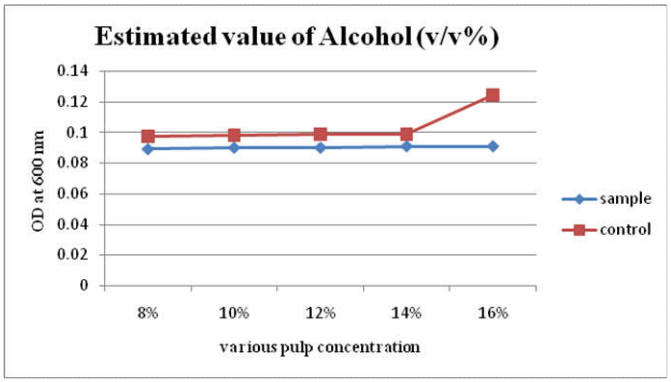

Figure 4. Estimated alcohol concentration in various pulp concentration (alcohol by volume)

Sugar content optimized grape juice and its storage studies

Figure 5 indicated some differences in the pH level after 25 days of optimized and stored grape juice when compared to day 1 samples. Decrease of pH level indicated the increase in acidity of both control and treated samples. Low pH of the juice inhibited the growth of the microrganisms. Addition of chemical preservatives changed the pH of the grape juice.

Decrease in ºBrix values indicated the alcoholic fermentation in stored grape juice. The sugar content of stored grape juice was optimized to 15 ºBrix (TSS), after storage of 25 days showed significant differences in the sugar content of grape juice (Figure:6) Acidity in % of tartaric acid was estimated by titration method. Since, the major organic acid present in grape juice is tartaric acid.

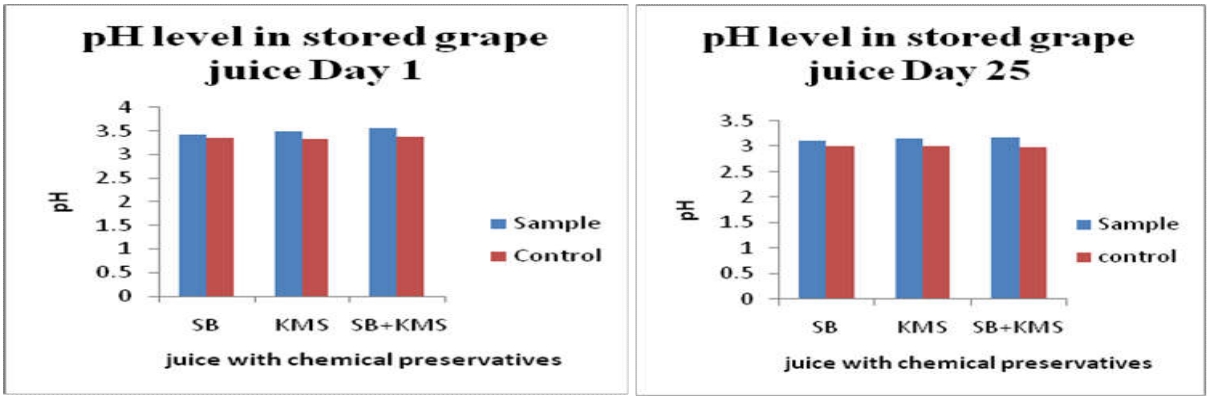

Figure 5. pH level in optimized grape juice (Day 1 & Day 25)

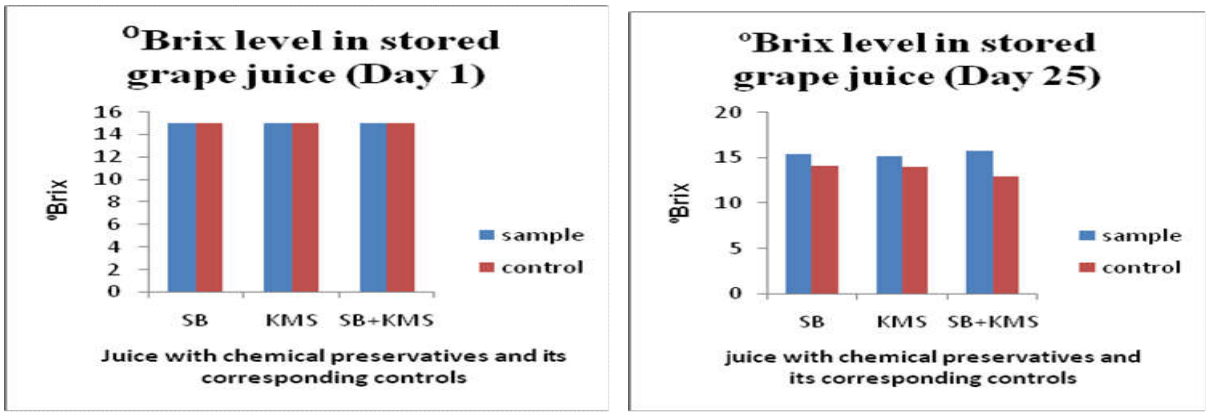

Figure 6. ºBrix level in optimized grape juice (Day 1 & Day 25)

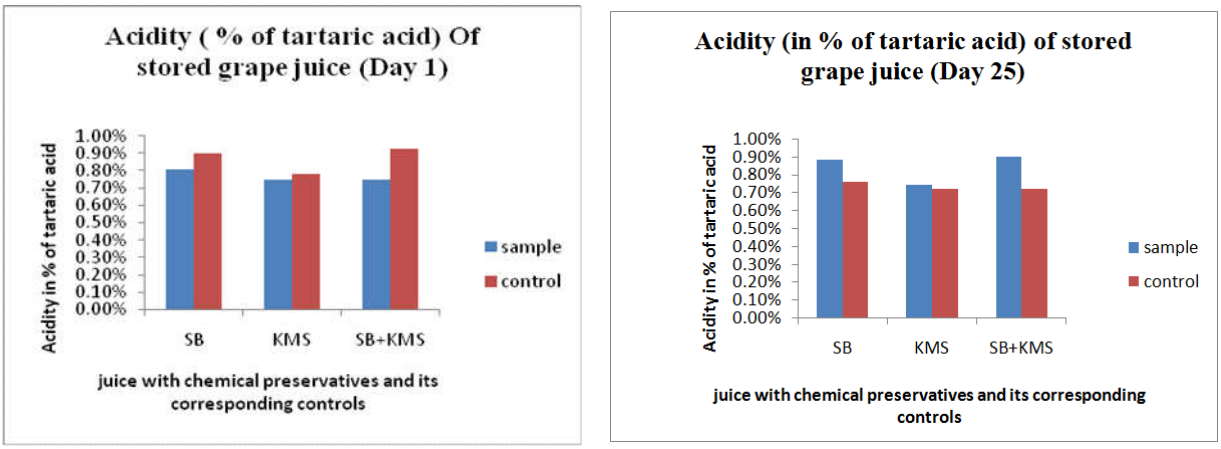

Figure 7. Acidity (in % of tartaric acid) in optimized RTS grape beverage (Day 1 & Day 25)

Temperature was also one of the important factor for decrease of the pH in the grape juice. When the temperature increases, the pH will decrease. Thus citric acid began to dissociate, there by number of H^+ ions also increased. It resulted in low pH of stored grape juice. ºBrix (TSS) is a scale based value, 1ºBrix is one gram of sucrose in 100 grams of solution.

Determination of acidity was important to estimate the organoleptic studies of grape juice, thus the high acid content led to sour taste in grape juice. Here the acidity is increased, and the organoleptic characteristics are changed (Figure 7). The reducing sugars and total reducing sugars which were estimated in day 1 and day 25 of the stored sample, indicated

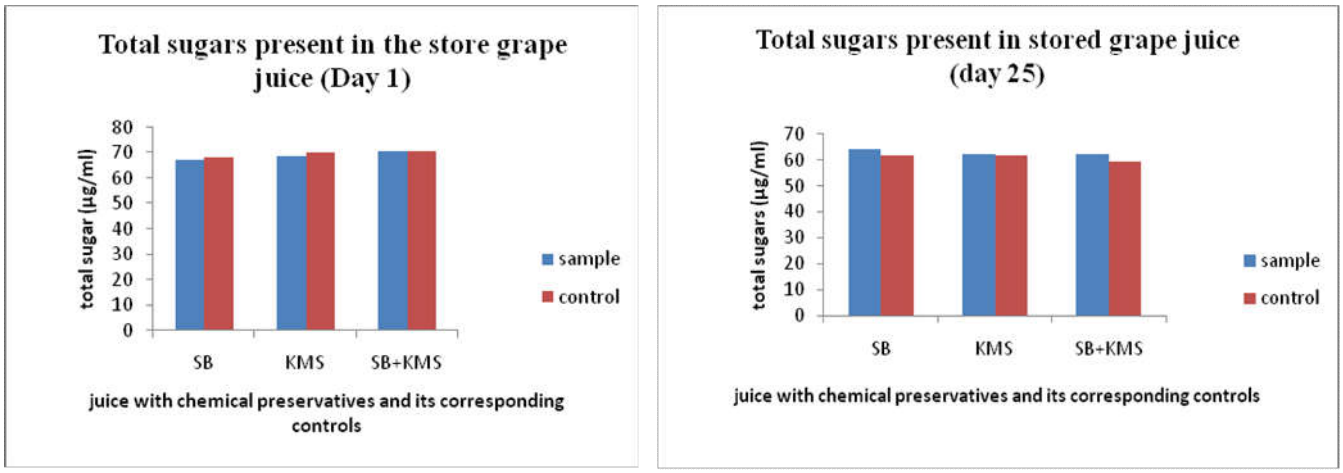

Figure 8. Total sugars in optimized RTS grape beverage (Day 1 & Day 25)

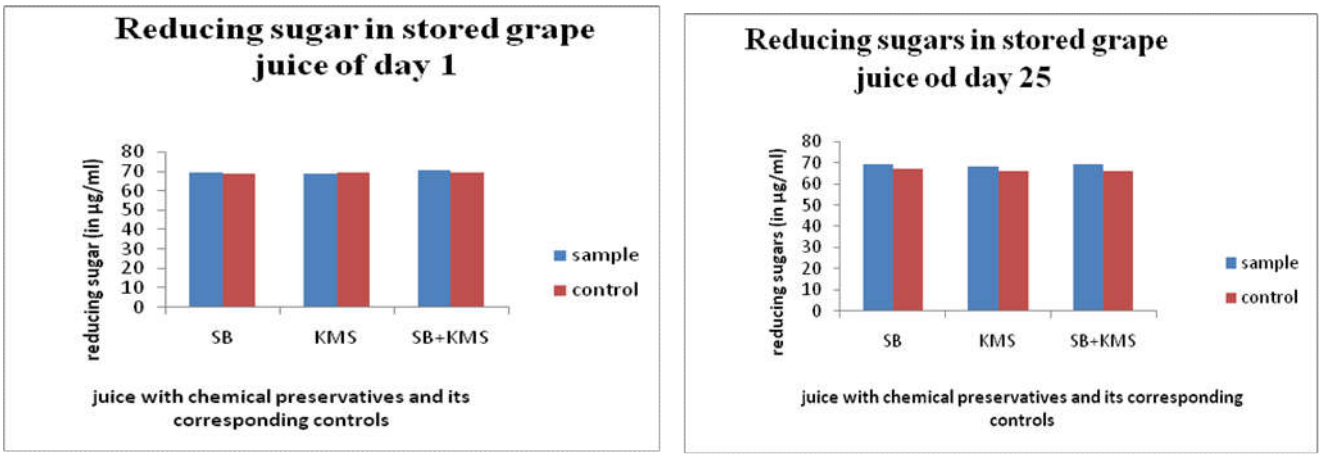

Figure 9. Reducing sugars in optimized RTS grape beverage (Day 1 & Day 25)

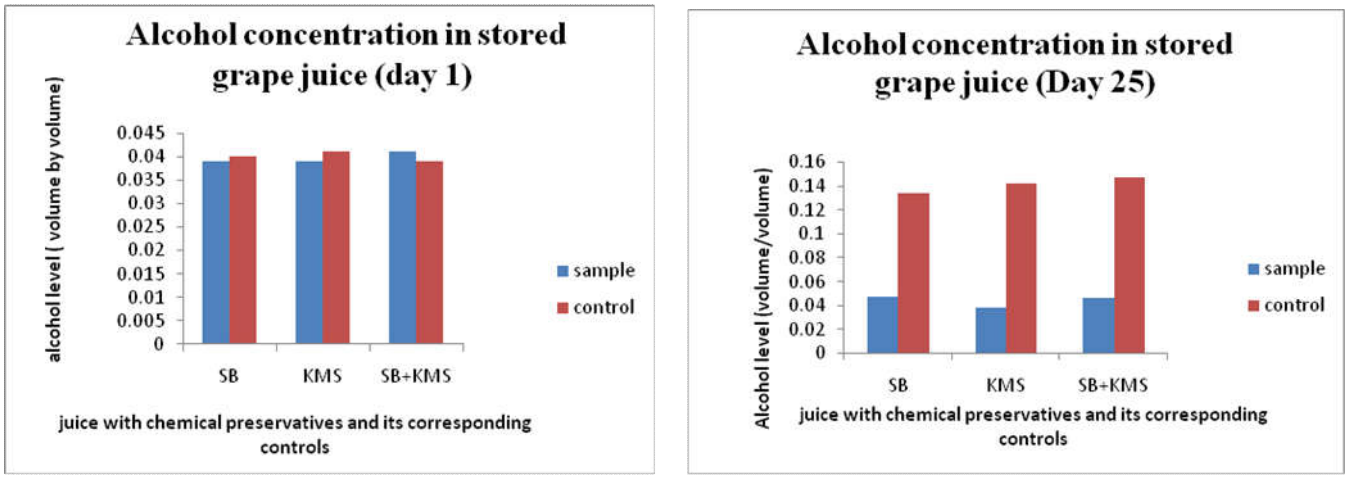

Figure 10. Estimated alcohol concentration (alcohol by volume)

insignificant difference in treated samples and significant differences in the control sample (Figure 8&9) Figure :9 indicated that the grape juice with chemical preservatives inhibited the growth of microbes, thereby inhibited fermentation of the grape juice. And there was no fermentation in the grape juice, the crystals of KMS reacted with the acids present in it and then SO_2 was released and formed sulphurous acid with the water of juice, which retarded the growth of bacteria, yeast , fungi, and moulds. Absorption of benzoic acid in to the cell decreased the intracellular pH and there was no anaerobic fermentation of glucose, thus it inhibited the growth & survival of the microrganisms.

Chemical food preservatives which were added in very low quantities (0.1%), did not alter the organoleptic properties of the juice and it also prevented the oxidation in grape juice.

Conclusion

The present study showed that shelf-life of beverages could be extended by adjusting the juice quantity and ° Brix (TSS) value. The chemical preservatives such as SB, KMS, combination of both inhibited the growth of microbes and it can be stored for several months. Thus, thermal processing and preservation by chemical preservatives was a useful approach

for fruit RTS (ready-to-serve beverage) beverage preservation. The organoleptic studies of preserved grape juice and its alcohol estimation indicated that sodium benzoate alone and combination of sodium benzoate and potassium meta bisulphte showed significant preservation effect in grape juice. The products based on these techniques possed many advantages such as the retention of sensorial qualities and nutritional values. Chemical preservatives used in the beverage was under the permissible limits by FSSAI, it would not cause much problems to human health, thus it can be commercially used.

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