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Effect of microwave on sugarcane juice preservation

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Sugarcane juice gets spoiled quickly due to physical, microbial and enzymatic degradation. In present investigation an attempt has been made to preserve sugarcane juice with the help of microwave processing. Sugarcane variety CoLk 94184 were harvested from the farms of Indian Council of Agriculture Research-Indian Institute of Sugarcane Research, Lucknow (Uttar Pradesh). Peeled sugarcane sticks was subjected to heat treatment at 10 psi for 5 minutes and then sticks was immediately cooled in a deep freezer and juice was extracted through sugarcane juice extraction machine followed by the addition of lemon juice to maintain the pH 4.2-4.3. After this the juice was subjected to microwave treatments for time period of 1-4 minutes. Fresh sugarcane juice was taken as control. All the treated juices were bottled and pasteurized in hot water at 80ºC for 25 minutes. All the lots were stored under refrigerated condition. The prepared juices were observed for physico-chemical and microbiological aspects like pH, total soluble solids, colour (L*, a*, b* values), total plate count, yeast and mould count along with sensory evaluation (overall acceptability). Changes in the above characteristics were observed and analyzed. From the results obtained it was clear that the overall performance of the above characteristics was found best when the juice was preserved by using microwave treatment for time period of 3 minutes (T_3) which enhanced the shelf-life of sugarcane juice for upto 56 days.

Key Words : Sugarcane juice, Heat treatment, Storage, Microwave, Preservation

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INTRODUCTION

In India sugarcane is generally crushed to obtain juice which serves as a thirst quenching drink in hot summers. Sugarcane juice is of great importance for recharging energy because it is rich in carbohydrate and iron. Being a nutritious product containing natural sugars, minerals and organic acids, sugarcane juice has also many medicinal properties. It strengthens the stomach, kidneys, heart, eyes, brain and sex organs. The juice is beneficial in fevers. Sugarcane juice is very useful in scanty urination. For better results, it should be mixed with lime juice, ginger juice and coconut water. Mixed with lime juice, it can hasten recovery from jaundice. Sugarcane juice is a fattening food. It is thus an effective remedy for thinness. Rapid gain in weight can be achieved by its regular use (Karthikeyan and Samipillai, 2010).

This drink is also quite common in other countries, such as Malaysia (Qudsieh *et al*., 2002), India and Cuba (Alonso Pippo *et al*., 2007). However, processing and

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marketing of sugarcane juice is limited by its rapid deterioration (Prasad and Nath, 2002 and Yusof *et al.*, 2000).

Extracted juice from the canes turns dark brown and marked sedimentation appearsduring storage. Conventional heating process imparts thetaste of jaggery and delicate flavours of juice is adversally affected (Kumar and Singh, 2016).Therefore, thermal processing at higher temperature is not possible in the case of sugarcane juice. In circumstances where thermal processing is impractical, minimal processing employing different barriers to microbial growth can enhance product stability. Hygiene standards are usually not maintained during the transport of sugarcanes from field to the point of extraction and during preparation by the vendors of the juice.Thus, good sanitation is the first barrier to reduce microbial load and low storage temperature further retards growth. An acid environment of pH less than 4.5 restricts the growth of many organisms. Mostly fruit juices are acidic and can be used for acidification of sugarcane juice. Antimicrobial substances, either natural or chemical preservatives, also assist. It has been observed that low temperature storage is able to extend the shelf-life of the juice for a few days.

Kumar and Singh (2017) have made an attempts to preserve sugarcane juice by combining the effects of pasteurization, preservatives and enzymes. Many scientists' *viz*., Prati *et al.* (2005) and Rezzadori (2010) reported that sugarcane juice pasteurization can be done with and without the addition of fruit juices. But the effect of microwave heating without adding preservatives on the stability of sugarcane juice has not yet been addressed. Keeping all these points in view, the present study was undertaken to study the effect of microwave on sugarcane juice preservation and to develop a protocol for preservation of sugarcane juice.

METHODOLOGY

The fully matured sugarcane sticks of variety CoLk 94184 were harvested from the farms of ICAR-Indian Institute of Sugarcane Research, Lucknow. The sugarcane sticks were then washed, graded, deeply peeled and scrubbed with the help of peeler. Then sugarcane stems were heat treated in autoclave (5 minutes at 10 psi). The stems then kept in deep freezer for the immediate cooling. After cooling juice was extracted using the sugarcane juice extraction machine and filtered through muslin cloth to remove the extraneous matter. The extracted juice was then immediately placed in deep freezer to prevent any further changes in juice colour.

Selection of treatments:

Different lots of sugarcane juice were subjected to following time intervals of microwave treatments during processing: T_1=1 min,T_2=2 min,T_3=3 min and T_4=4 min.

In all the treatments (T_1, T_2, T_3 and T_4) juice was filled in sterilized glass bottles and bottles were tightly capped by manual bottle capping machine, and after that heat treatment (80ºC for 25 minutes) was given in the hot water bath.Thereafter bottles were kept in refrigerator. The samples were drawn and analyzed periodically for physico-chemical, microbiological and sensory attributes at an interval of 7 days.

Physico-chemical and microbiological analysis:

pH:

Hanna pH meter, (model No. HI 5521), made in Romania was used to determine pH. It consists of a probe for measuring pH.

Total soluble solutes (*T.S.S.*):

LCD digital bench- ATAGO Pocket Refractometer, PAL-MAPLE (Made in Japan), model number B623777 was used to determinethe total soluble solutes in sugarcane juice.

Colour:

Konica Minolta Sensing, CR-10, was used to determine colour. The colour reader reading appeared on the screen and was noted in L*, a*, and b* values.

Microbiological analysis:

The quality of sugarcane juice was based on the number and type of micro-organism present which can be assessed by serial dilution and plating method for the differential enumeration of bacteria, yeast and fungi (Ranganna, 2007). Determination of total microbial counts (bacteria, yeast and mould) for juice was carried out at every 7 days interval. 1 ml of juice from each storage temperature was taken into a test tube containing 9 ml of sterile water. The mixture was homogenized. This homogenate represented 10^{-1} dilution. From here, serial dilutions of 10^{-2} and 10^{-3} were prepared. The plates were

then incubated at room temperature for 24 h for bacteria and four days for yeast and mould. Enumeration of bacteria and yeast and fungi was counted by nutrient agar media and rose bengal media, respectively, with 10^{-3} dilutions. The results (number of colony forming units) were obtained after the incubation time using the following formula:

Number of colony forming units (CFU' s) per gram of sample $= \frac{\text{Number of colonies}}{\text{Amount of solution taken in x dilution}}$

Sensory evaluation:

Juice samples were also evaluated for sensory attribute mainly overall acceptability using a 5 member panel using a 9 point Hedonic scale (Amerine *et al.*,1965). The panel members were requested to assemble at one place prior to evaluation, as the samples were required to be judged immediately when opened. Each member was provided with the sensory evaluation rating scales based on which the rating was given to various samples. The average values of the ratings given by all the members were then calculated and used for further analysis.

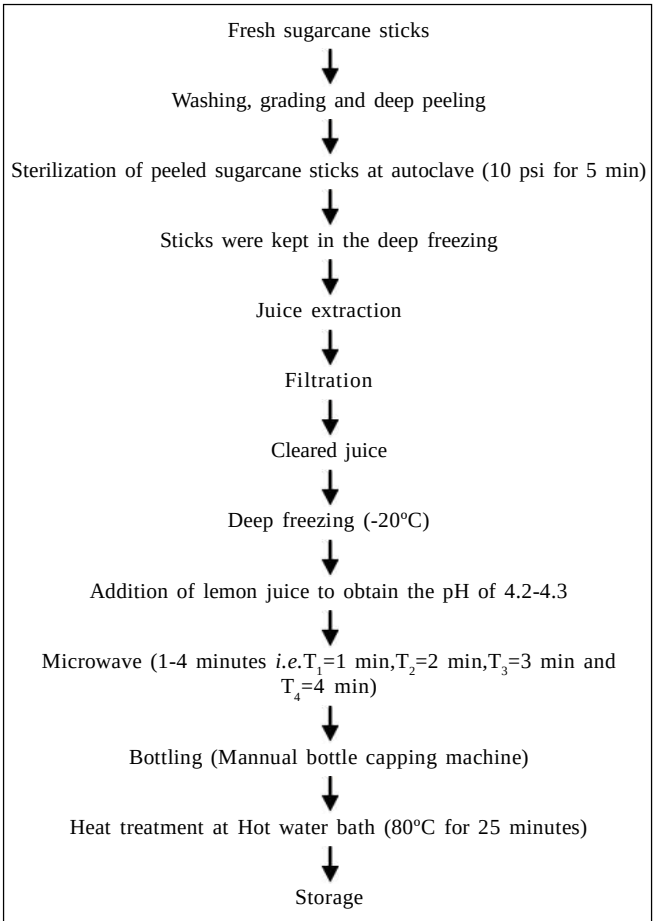

Fig. A: Process flow chart of sugarcane juice preservation

Statistical analysis:

The experiments were conducted by adopting Factorial Randomized Completely Block Design by using software Windostat version 8.6 from indostat service. The data recorded during the course of investigation were statistically analyzed by the 'analysis of variance' (ANOVA) described by Steel *et al.* (1997). Analysis of variance was used in all the analysis for detection of significant differences among samples. The significant effect of treatment was judged with the help of 'F- test' (variance ratio). Calculated F value was compared with the tabulated value of F. If calculated value exceeded the tabulated value, the effect was considered to be significant. Standard error and critical difference were calculated on the basis of Anova table.

OBSERVATIONS AND ASSESSMENT

Fresh sugarcane juice sample spoiled within 7-8 hours at refrigeration temperature, therefore, results for control could not be obtained for the storage period. Similar results were observed by Chauhan *et al*. (2002).

Physico – chemical changes during storage of sugarcane juice:

Data presented in Fig. 1 clearly indicated that the pH increased duringstorage. Initially, the pH was maintained at 4.2 for all the treated juice. Then pH was slightly increased at the end of storage studies.

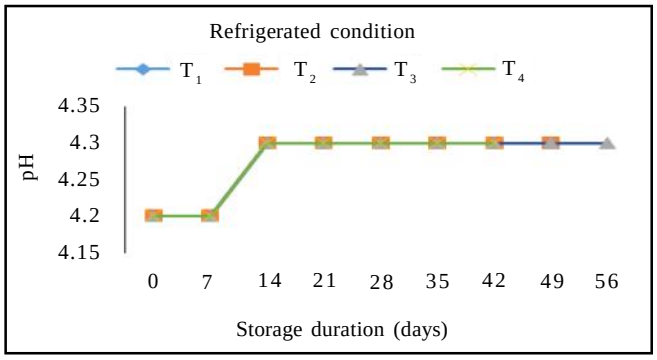

Fig. 1 : Effect of treatments on pH values of sugarcane juice stored under refrigerated condition

Fig. 2 clearly indicates that the decrease in total soluble solids was observed during storage. This may

bedue to the conversion sugars to acids during stor- age. Similar results were observed by Verma *et al.* (2016). However, maximum T.S.S. was observed in T_3 at the end of storage studies. Addition of lemon (citric acid) to heat treated sugarcane juice beverage restricted the degradation of total soluble solids and total sugar during storage at refrigeration temperatures (Khare *et al.*, 2012).

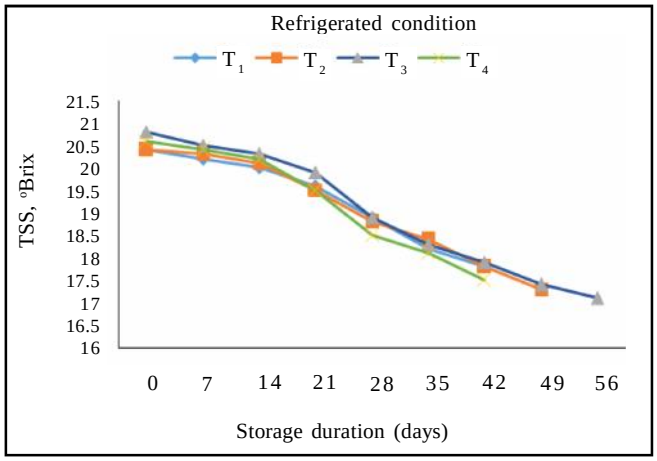

Fig. 2 : Effect of treatments on TSS values of sugarcane juice stored under refrigerated condition

The L* indicates intensity of colour *i.e.* lightness which varies from L*=100 for perfect white to L*=0 for black. "a*" is a chromaticity designation of colour *i.e.* thevalue of 'a*' measured redness when positive, grey whenzero and greeness when negative.The value of b* measured yellowness when positive, grey when zero and blueness when negative.In the present study as depicted from the Fig. 3, 4 and 5 treatment T_3 has shown the most

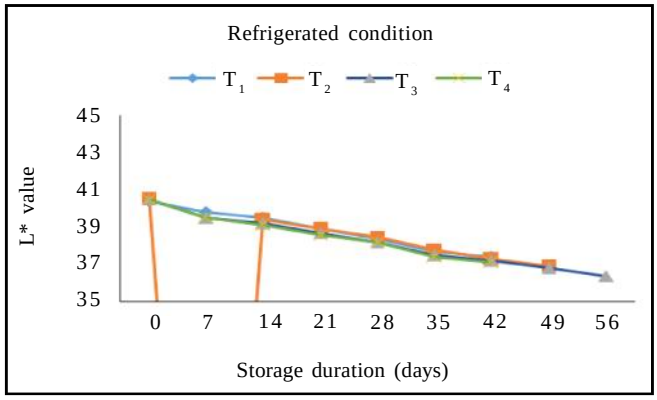

Fig. 3 : Effect of treatments on L* values of sugarcane juice stored under refrigerated condition

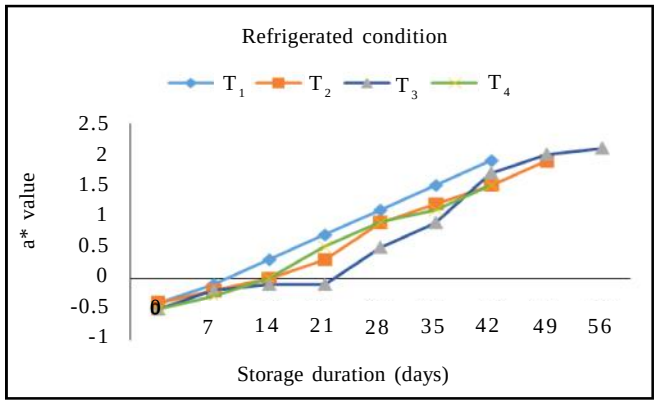

Fig. 4: Effect of treatments on a* values of sugarcane juice stored under refrigerated condition

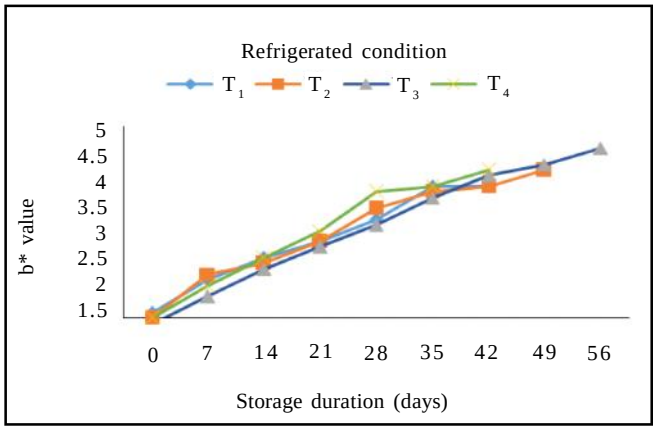

Fig. 5: Effect of treatments on b* values of sugarcane juice stored under refrigerated condition

favourable attributes of colour *i.e.* L*, a* and b* values. In other treatments comparatively more browning was observed. This may be due to the enzymatic browning and marked sedimentation in these treatments.

Microbiological changes during storage of sugarcane juice:

During the present investigation, total plate countincreased significantly in all the treatments at all the levels of storage as depicted in the Fig. 6.The increase in the total plate count was due to the increase in the microbial count which rises with time (Pelczar *et al.*, 1993). However, minimum growth was observed at T_3. From the results of the present study as presented in the Fig. 7 it was clear that the yeast and mould count was increased significantly in all the treatments at all the levels of storage and minimum growth was observed in T_3.

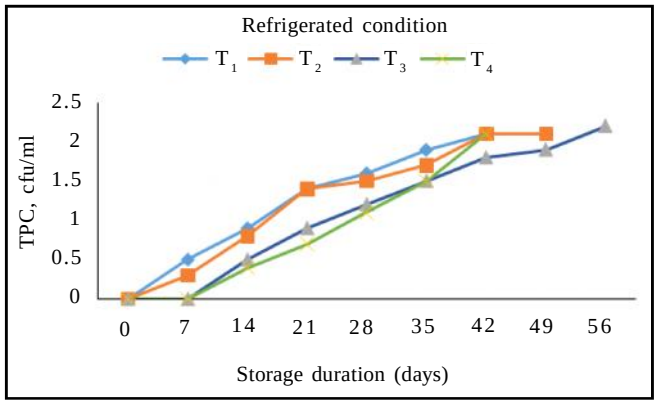

Fig. 6: Effect of treatments on total plate count (×10 ^{5}cfu/ml) values of sugarcane juice stored under refrigerated condition

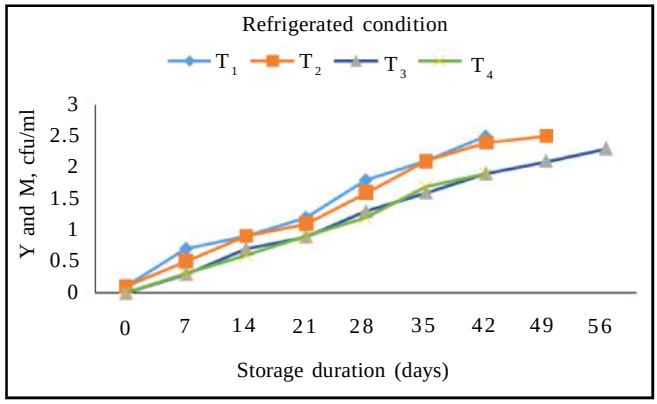

Fig. 7: Effect of treatments on yeast and mould count (×10 ^{5}cfu/ml) of sugarcane juice stored under refrigerated condition

During the present investigation, yeast and mould countwas increased significantly in all the treatments at all the levels of storage as depicted in the Fig. 7. However, comparatively lower growth was observed in T_3 and T_4.

Changes in sensory scores during storage of sugarcane juice:

Sensory evaluation regarding overall acceptability were carried out and mentioned in Fig. 8.

The initial scores for all treated juice was ranged from (8.5) to (9.0) for 0 days after that flavour decreased significantly during storage of sugarcane juice under refrigerated condition.

Conclusion:

It can be concluded from the present investigation that good quality beverage from sugarcane juice of variety

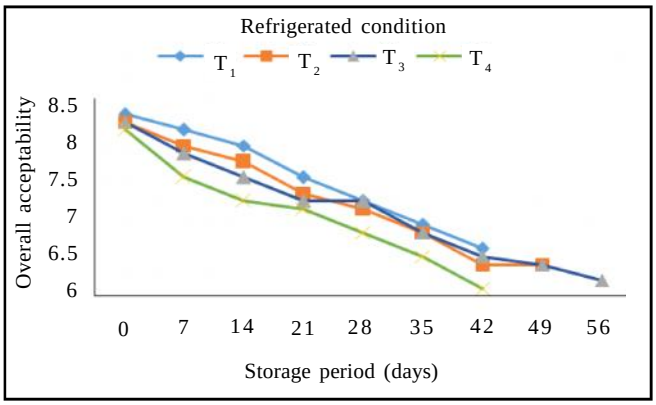

Fig. 8: Effect of treatments on overall acceptability of sugarcane juice stored under refrigerated condition

CoLk 94184 with satisfactory storage stability of 56 days at refrigeration could be achieved by the use of microwave treatment without adding preservatives. The microwave treatment had a significant impact on the shelf- life of the sugarcane juice because the treated juice could retain the characters like T.S.S., pH, total plate count, yeast and mould count and organoleptic characters for a longer duration. At the end of storage studies T_3 was the best for retaining the various physico-chemical, microbiological and organoleptic characters.

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