The Andhra Agric. J 63 (2): 415-421, 2016

A Comparative Study of Thermally Treated and Untreated Sugarcane Juice

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ABSTRACT

Sugarcane juice is commonly used as a delicious drink in both urban and rural areas. Sugarcane juice is spoiled quickly due to the pres-ence of simple sugars. Preservation of sugarcane juice was examined to reduce the spoilage and to increase the shelf life using thermal treatment. A study was carried out to preserve sugarcane juice by thermal treatment and compare with the untreated juice. The result revealed that good quality sugarcane juice of variety CO380 with satisfactory storage stability at refrigeration could be prepared by heat treatment at 80°C for 5 min. Physico – chemical analysis revealed that the TSS, colour and pH value of sugarcane juice decreased during storage. The TSS of thermally treated juice ranged from 22 to 19.9 % during its storage. The pH was recorded as 4.65 for thermally treated juice. Thermally treated juice showed lower reduction in total sugars from 20.3 to 18 % during storage period. The reducing sugars increased during storage. The turbidity of thermally treated juice was very less it ranged from 70.2 to 50.7 % during its storage. The thermally treated juice gave good results when compared to untreated sugarcane juice.

Key words : Sugarcane juice, Thermally treated, Preservation, Simple sugars, Total sugars, Reducing sugars and Turbidity.

Sugarcane *(Saccharum officinarum L.)* is an important industrial crop cultivated in tropical and subtropical regions of the world. India is the world second largest producer of sugarcane next to Brazil. Sugarcane has been used as a sweetener for millennia and today refined sugar is used in copious quantities to supplement the natural sugar found in fruits and vegetables.

A part of sugarcane juice is consumed as inexpensive and pleasing beverages in India. It possesses therapeutic value. Sugarcane juice is commonly used as a delicious drink in both urban and rural areas. Sugarcane juice of 100 ml provides 40 Kcal of energy, 10 mg of iron and 6 ìg of carotene. Sugarcane juice is rich in enzymes and has many medicinal properties. It contains water (75%-85%), reducing sugar (0.3-3.0%) and non-reducing sugar (10-21%). Sugarcane juice is a great preventive and healing source for sore throat, cold and flu. Even the diabetic can enjoy this sweet drink without worrying about calories. It hydrates the body quickly when exposed to prolonged heat and physical activity. It is an excellent substitute for aerated drinks and colas; it refreshes and energizes the body (Ashish *et al.,* 2012). Due to its commercial importance, it is envisaged that sugarcane juice production can become a profitable business provided efforts are made to preserve its fresh quality during storage (Krishnakumar *et al.,* 2013).

In general sugarcane juice is spoiled quickly due to the pres-ence of simple sugars. Soon after the harvest of sugarcane, endogenous invertase enzyme is activated and acts as a cause of deterioration. These enzymes lead to inversion of sucrose and affect the quality of sugar. The polyphenol oxidase is the major enzyme involved in the discoloration of sugarcane juice which can be improved by heat inactivation of enzyme. The sugarcane juice can be introduced as delicious beverage by preventing the spoilage of juice with appropriate preservation method. One of the processes indicated to enable the sugar cane juice industrialization is the clarification, which can be achieved through two methods: the conventional filtration method adapted to consumption, and by

thermal treatments for extending shelf life of sugarcane juice. Addition of lemon and ginger followed by pasteurization and preservation with sodium benzoate also reduced physico-chemical changes during storage of ready-to-serve bottled sugarcane juice (Ashish *et al.,* 2012).

The fresh sugarcane juice has its own typical flavour, but the product is so perishable that the time-lag between the extraction and consumption has a marked deteriorating effect on its sensory characteristics. Hence, addition of lemon and ginger with sugarcane juice may not only improve nutritive value of sugarcane juice but also improve clarification and preservation resulting in the increase in the overall acceptability of sugarcane juice (Sangeeta *et al.,* 2013). So, it is necessary to process and preserve the juice to improve its shelf life and marketing characteristics and thus scale up the production and consumption of sugarcane juice. The objective of present study was to investigate thermal processing of sugarcane juice and to conduct quality analysis of thermally treated and untreated sugarcane juices.

MATERIAL AND METHODS

The raw materials i.e. Sugarcane CO380 variety was obtained from a local farmer of Thoreddu village, East Godavari dist, Andhra Pradesh. Sodium Benzoate, bottles of 250 ml capacity were procured from the market. Sugarcane stems with good quality and without any pest or disease infestation were selected and peeled for juice extraction. Sugarcane juice crusher, Hot air oven, autoclave, Pocket Refractrometer (ATAGO make, range 0-93%), Systronics µ pH system 362, Hunterlab color flex meter (M/ S.Hunterlab, Reston, VA, USA, and Model CFLX-45), Systronics Spectrophotometer 166 were the equipments used in thermal processing of sugarcane juice. The colour was expressed as Chroma value (Lo *et al*., 2007) Chroma = $(a^{*2} + b^{*2})^{1/2}$. Lane and Eynon method, stated by Ranganna, 1986 was used for estimation of sugars.

Reducing sugars % = (factor 0.052)* dilution*100) / (titre *wt. of sample)

Total sugars % = (factor(0.052) *dilution*100) / (titre *wt. of sample)

Sugarcane juice was extracted by power operated two horizontal roller type juice extractor and filtered through the muslin cloth to remove the extraneous matter.

The juice formu-lation was done by the addition of ginger extract and lemon extract to sugarcane juice in proper concentration as stated below and the samples were refrigerated. The prepared mixture of ginger extract, lemon juice and sugarcane juice was filtered through muslin cloth and is subsequently used as a raw material for processing. This mixture is referred as sugarcane juice here after. In the thermal method, the sugarcane juice was preheated at 50°C for 10 min duration and sodium benzoate (Masamba *et al*.,2013) of 175 ppm was added, crown bottled and pasteurized at 80°C for 5 min duration in an autoclave. Then the bottles were refrigerated for storage. For control samples, sugarcane juice was collected, bottled and refrigerated for storage.

RESULTS AND DISCUSSION

The physico-chemical characteristics of the thermally processed and untreated sugarcane juice such as %Brix, Total sugars, colour, pH, Reducing sugars, Turbidity were determined (Table 1 & 2).

TSS was initially high for both the juices and then gradually decreased. The TSS of untreated juice was very high (22.9 %Brix) initially and then decreased to 13 %Brix (Table.2) and it became stable at 13 %Brix. The TSS of treated juice was also high initially and then decreased from 22 to 19.9 %Brix (Table.1). The TSS of Sugarcane juice normally consists of sugars, natural flavorings, pigments and other nutrients. The initial increase of TSS in thermally treated juice on 4th day and in untreated juice on 4th and 8th days (Fig. 1) might be due to breakdown of complex sugars into simple sugars. Thereafter, the gradual decrease in TSS is due to fermentation process where sugars are converted into acids.

The levels of pH in preserved juidecreased upon storage (Table.1 and Table.2). The pH was very low on 20th day compared to all other samples because of no treatment to this juice, due to which fast fermentation reactions took place. In thermally treated samples, change in pH was low due to thermal treatment by which fermentation process was delayed.

The total sugars content decreased upon storage for all the sugarcane juice samples. The

Table 1. Quality parameters of thermally treated sugarcane juice.

Parameters	Storage Period, Days					
	0	4	8	12	16	20
Total Soluble Solids, % Brix	22	24	23	21.2	20.9	19.9
Ph	5.4	5.01	4.85	4.75	4.7	4.65
Total Sugars,%	20.3	19.6	19.1	18.5	18.0	17.5
Reducing Sugars,%	1.31	1.47	1.54	1.65	1.71	1.73
L*	44.2	46.5	48.9	50.1	52.5	52.5
A*	-2.00	-1.80	-1.50	-1.10	-0.50	-0.40
B*	52	48	43	39	35	33
Chroma	52.03	48.03	43.02	39.01	35.00	33.00
Turbidity,%	70.2	65.0	68.3	58.6	50.2	50.7

Table 2. Quality parameters of Untreated sugarcane juice.

Parameters	Storage Period, Days					
	0	4	8	12	16	20
Total Soluble Solids, % Brix	22.9	27.2	29.6	18.1	17	13
pH	5.45	5.25	4.98	4.77	4.58	4.37
Total Sugars,%	23.6	20.2	18.8	16.4	14.4	13.0
Reducing Sugars,%	1.46	1.54	1.58	1.62	1.78	2.09
L*	30.8	49.2	57.3	69.1	88.2	95.4
A*	-2.50	-2.20	-1.80	-0.85	-0.71	-0.61
B*	45	37	28	17	14.5	07
Chroma	45.11	37.09	28.05	17.02	14.51	07.02
Turbidity,%	68.7	61.1	54.5	50.0	43.2	42.0

change in total sugars for the untreated juice during storage was from 23.6 to 13.0 %. For thermally treated juice, the decrease was from 20.3 to 17.5 % (Fig.3). The total sugars content decreased upon storage because of breakdown of total sugars into reducing sugars. Similar observations were made by Krishnakumar *et al*., 2013 The total sugar content of untreated juice decreased more compared to thermally treated samples because no treatment was given. The decrease in thermally treated juice was less because of thermal treatment due to which breakdown of sugars would have decreased and also the treated samples were refrigerated. Similar observations were made by Chauhan *et al*., 2002.

The reducing sugars of sugarcane juice generally increased upon storage. The levels of reducing sugars for untreated juice sample were high from 1.46 to 2.09 % during the storage. But the reducing sugars were low for thermally treated juice from 1.31 to 1.73 %. The reducing sugars increased during storage because of the breakdown

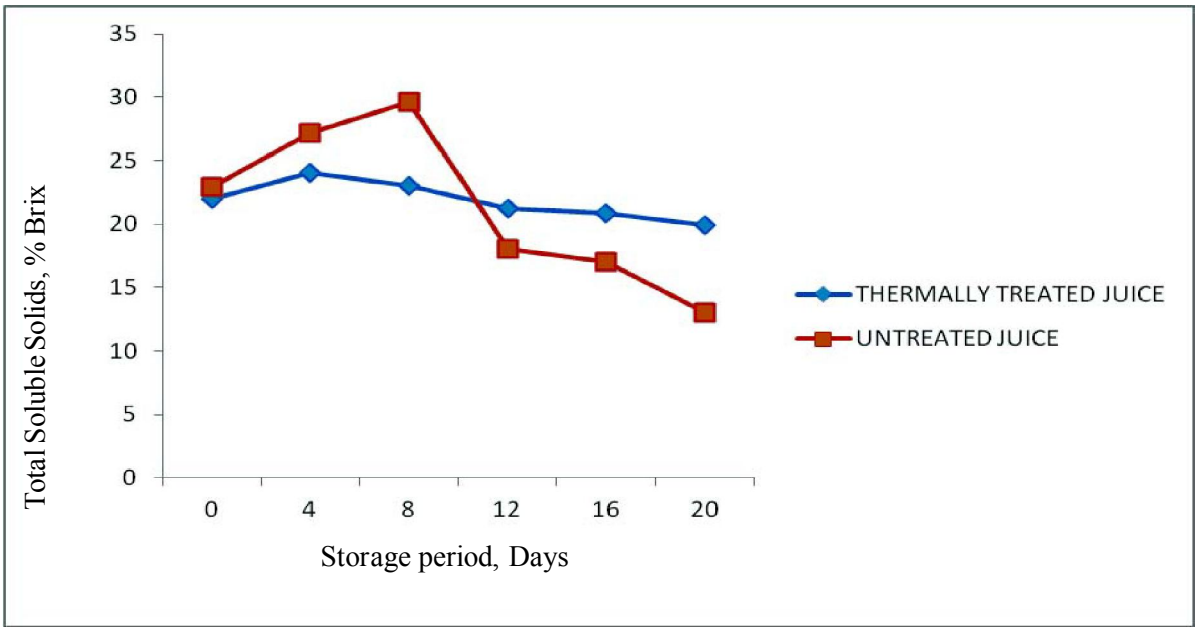

Fig. 1 Effect of storage period on TSS of stored sugarcane juice

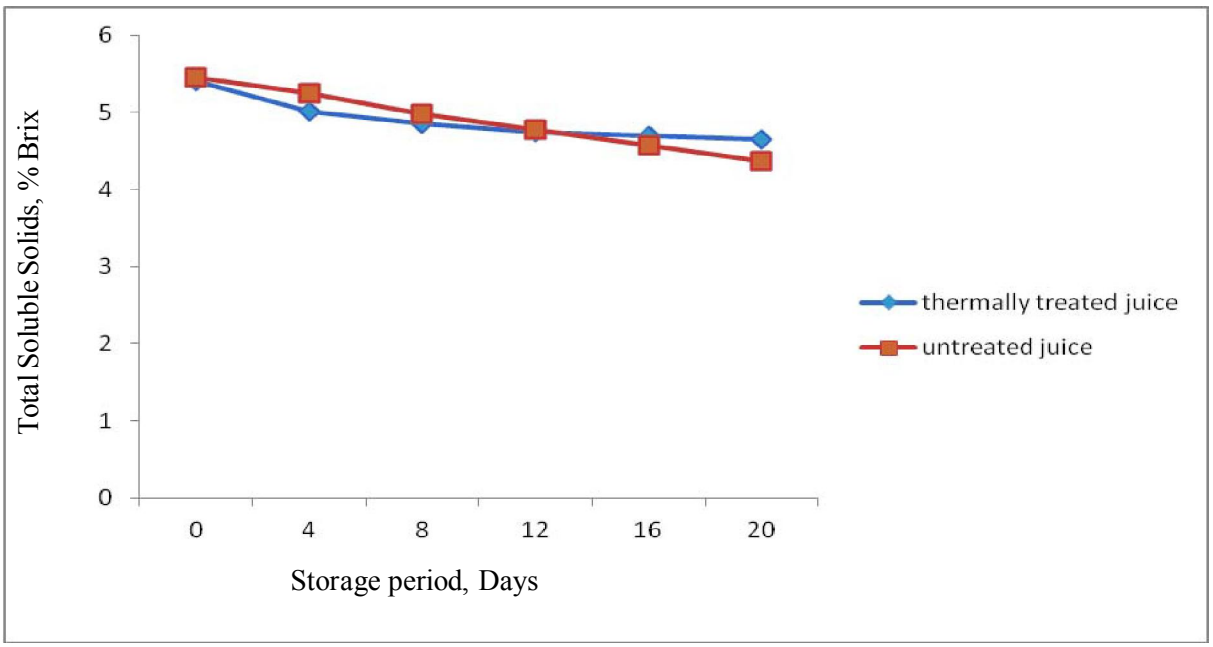

Fig. 2 Effect of storage period on pH of stored sugarcane juice

of total sugars into reducing sugars (Fig.4). The values of reducing sugars were high for untreated juice, as total sugars were converted into reducing sugars. The values obtained for thermally treated juice were low in reducing sugars because thermal treatment delayed the fermentation process of conversion of total sugars to reducing sugars.

The Turbidity of the sugarcane juice samples was measured at a transmittance of 900 nm using a spectrophotometer. It was evident that untreated juice had very low transmittance values of 68.7 to 42 % and for thermally treated juice, the values ranged from 70.2 to 50.7% during storage. Similar observations were made by Patricia *et al*., 2010. The turbidity of juice samples was observed to be increased during storage (Fig. 5). More turbidity was observed in for untreated juice because there was no treatment given to sample as a consequence of which faster fermentation process took place and breakdown of sugars was

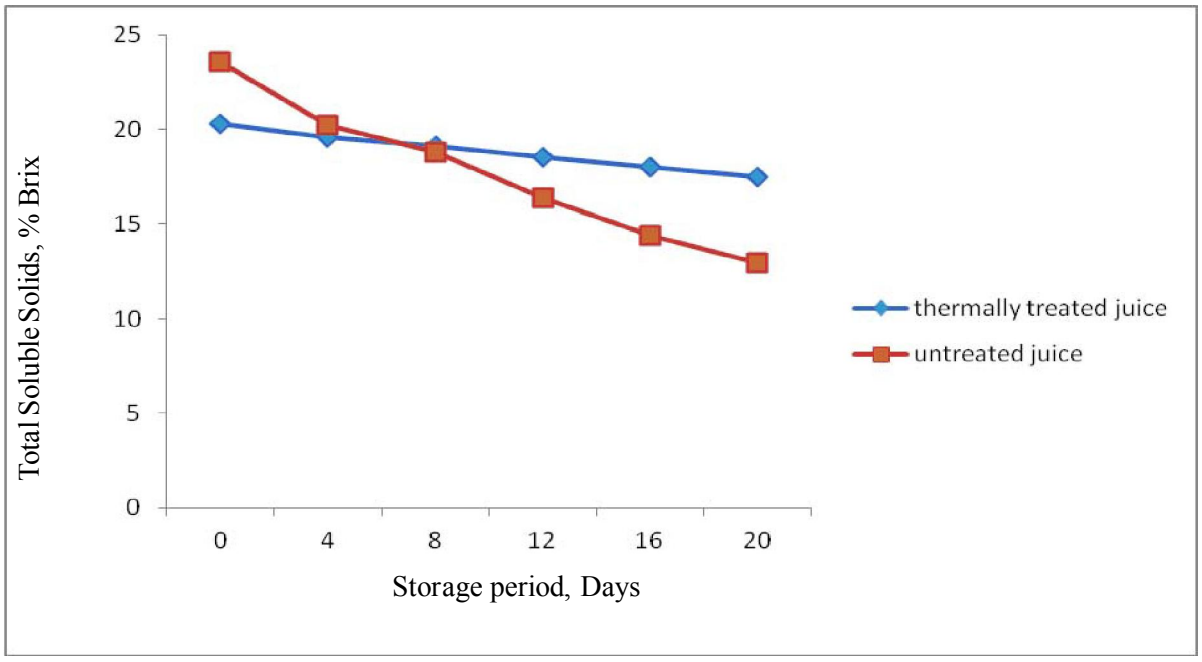

Fig. 3 Effect of storage period on total sugars of stored sugarcane juice

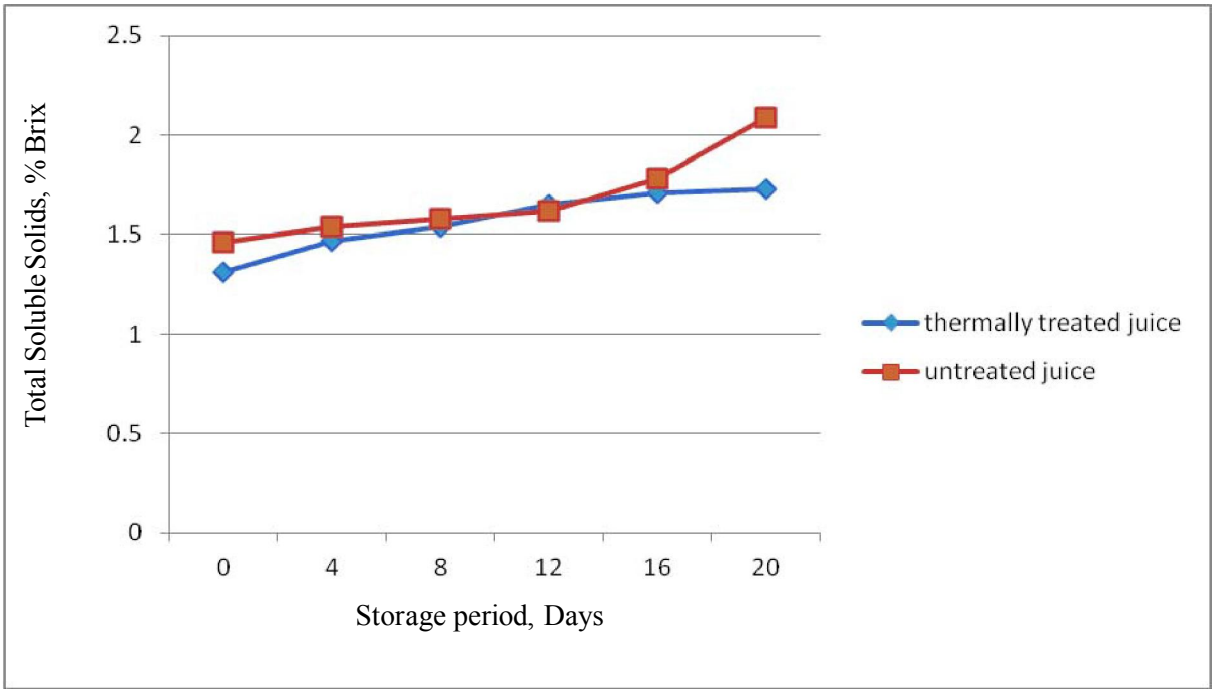

Fig. 4 Effect of storage period on reducing sugars of stored sugarcane juice

more and the light absorbance of the sugars was more. So, light transmission was less which resulted in increased turbidity of juice.

The color of fresh sugarcane juice was light lemonish yellow. Upon storage the color faded with time and attained a light whitish homogenous turbid solution at the end of 20 days. However, the fading of color was comparatively slower for themally treated juice than for untreated juice. Similar observations were made by Richa *et al.,* 2010. The L* value (100% means white and 0% means black) which represents lightness of all the samples increased. There was higher increase in untreated juice from 45.2 to 95.4. The juice became completely whitish turbid solution on 20th day. The thermally treated juice had lower values about 44.2 to

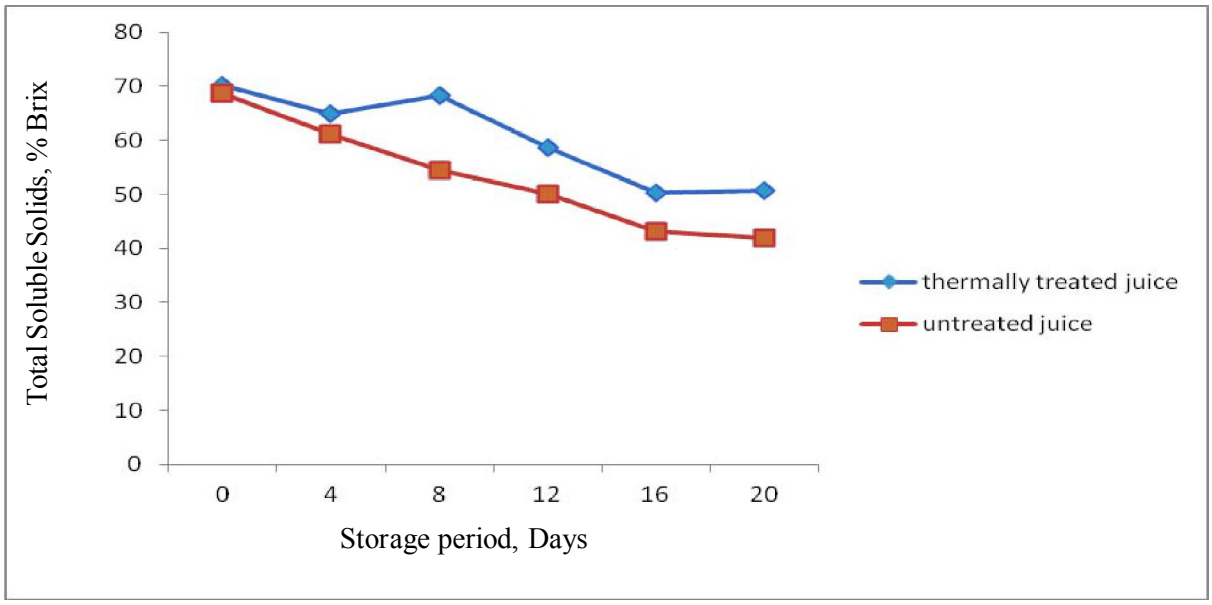

Fig. 5 Effect of storage period on turbidity of stored sugarcane juice

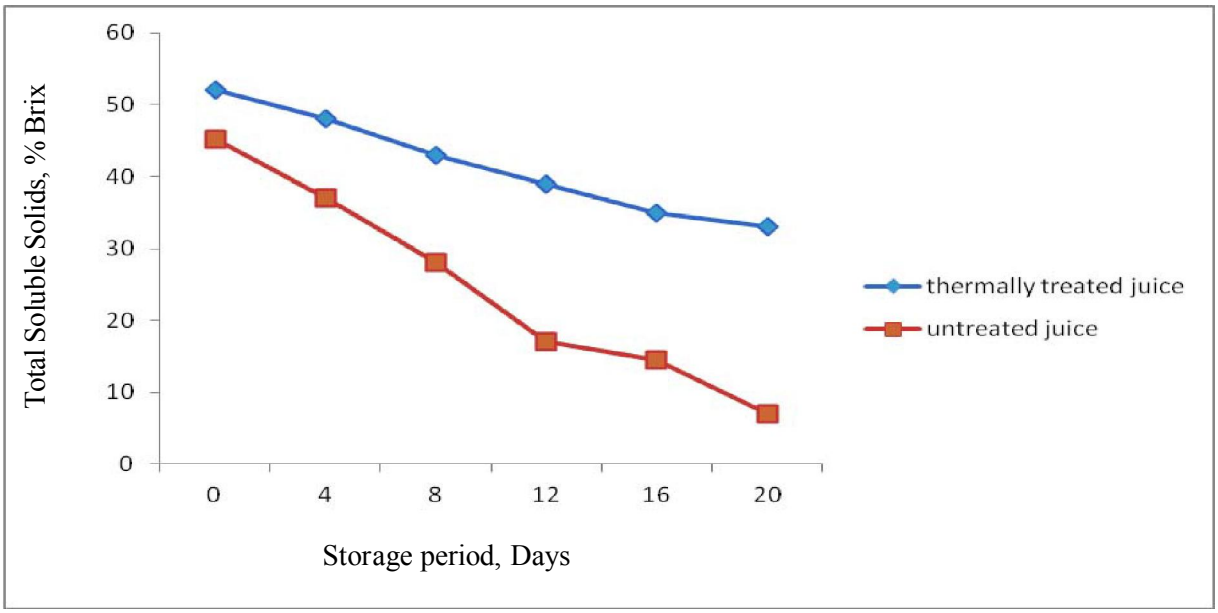

Fig. 6 Effect of storage period on chroma of stored sugarcane juice

61.3 because of thermal treatment given to sample. The a* value (+ means red and - means green) which represents redness of all samples decreased. The b* value (+ means yellow and - means blue) which represents yellowness of all samples decreased. All the L*, a*,b* and chroma values were shown in Table.1 and Table.2. The Chroma or Colour values decreased for all the samples during storage. It was high for thermally treated juice and decreased from 52.03 to 33 and for untreated juice it changed from 45.11 to 7.02 (Fig.6).

Conclusions

The result revealed that good quality sugarcane juice of variety CO380 with satisfactory storage stability in glass bottles at refrigeration could be prepared by heat treatment at 80°C for 5 min. Physico – chemical analysis revealed that the TSS, colour and pH value of sugarcane juice decreased during storage. The TSS of thermally treated juice ranged from 22 to 19.9 % during its storage. The pH was recorded as 4.65 for thermally treated juice. Thermally treated juice

showed lower reduction in total sugars from 20.3 to 18 %.. The reducing sugars increased during storage. The turbidity of thermally treated juice was very less and ranged from 70.2 to 50.7 % during its storage. The thermally treated sugarcane juice gave good results compared to untreated sugarcane juice.

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(Received on 19.06.2015 and revised on 20.09.2015)