# Studies on Shelf Life Extension of Sugarcane Juice

**THESIS**

*Submitted to the*

**Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur**

**In partial fulfillment of the requirements for the Degree of**

**MASTER OF SCIENCE**

*In*

**AGRICULTURE**

**(FOOD SCIENCE & TECHNOLOGY)**

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# CERTIFICATE – I

*This is to certify that the thesis entitled “**Studies on Shelf Life Extension of Sugarcane Juice**” submitted in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **Food Science and Technology** of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur is a record of the bonafide research work carried out by **Mr. Shekhar Gautam Dohre**, I.D. No. **160120009** under my guidance and supervision. The subject of the thesis has been approved by the Student’s Advisory Committee and the Director of Instructions.*

*All the assistance and help received during the course of the investigation have been acknowledged by him.*

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*This is to certify that the thesis entitled* **"*Studies on Shelf Life Extension of Sugarcane Juice*"** *submitted by* ***Mr. Shekhar Gautam Dohre*** *to the Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur in partial fulfillment of the requirements for the degree of* ***Master of Science (Agriculture)*** *in* ***Food Science and Technology.*** *In the Department of Food Technology has been, after evaluation, approved by the External Examiner and by the Student's Advisory Committee after an oral examination on the same.*

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## Declaration and Undertaking by the Candidate

I, Shekhar Gautam Dohre S/o Mr. Lakhan Lal Dohre Certify the work embodied in thesis entitled **"**Studies on shelf life extension of Sugarcane juice**"** is my own first hand bonafide work carried out by me under the guidance of Dr. S.S. Shukla, Professor, Department of Food Science and Technology, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur during 2017-2018.

The matter embodied in the thesis has not been submitted for the award of any other degree/diploma. Due credit has been made to all the assistance and help.

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Place: Jabalpur

Date: **Shekhar Gautam Dohre**

# LIST OF CONTENTS

## ABBREVIATION

| | | |
|---|---|---|
| % | = | Percent |
| i.e. | = | That is |
| viz. | = | Namely |
| Ml | = | Milliliter |
| Ppm | = | Part per million |
| G | = | Gram |
| RPM | = | Round per minute |
| p.s.i. | = | Pounds per square inch |
| et al. | = | Co-workers |
| w/v | = | weight/volume |
| ˚C | = | degree centigrade |
| T | = | Pasteurization temperature |
| Min | = | Minute |
| C | = | Citric acid |
| KMS | = | Potessium metabi sulphite |
| PS | = | Potessium sorbate |
| AA | = | Ascorbic acid |
| Fig. | = | Figure |
| Mt | = | Million tones |
| Mh | = | Million hector |
| Etc | = | et cetra |
| ºB | = | Degrees Brix |

# INTRODUCTION

Sugarcane (*Saccharum officinarum*) belongs to the family Gramineae. It is one of the most important agro-industrial crops in our country. The total production of sugarcane in India during the year 2017-18 was 330 million tones. Uttar Pradesh and Maharashtra are the two largest sugarcane producing states in the country, accounting for more than 80 percent of the annual crop production (Anonymous 2011). India stands second among other sugarcane growing countries, contributing nearly 20.40% area and 18.60% production. Sugarcanes are largely utilized for production of white sugar crystals, gur, khandasari and sugarcane juice (pattnayak and Misra, 2004).

Fresh Sugarcane juice is popular beverage in Southeast Asia, South Asia, Latin America, and also in other countries where sugarcane is grown commercially. It is known as “Oosacha Ras” or “Ganneka Ras” in Maharashtra in Marathi and Hindi accordingly. It is relished for its sweet taste and flavor. Sugarcane juice provide vitamins A, C, B1, B2, B3, B5, B6 and iron with a high concentration of phytonutrients (including chlorophyll), antioxidants, proteins, soluble fibre and numerous other health supportive compounds (Karthikeyan and Samipillai, 2010).

In the last couple of years, globally, the demand for sugarcane juice has been increased rapidly and as a result of which number of fruit processing industries have come up. These juice-processing industries use conventional technology to produce juice, which are not of high quality in terms of their sensory attributes.

Sugarcane juice is extracted using a crusher, operated either manually or mechanically. It is often freshly extracted and sold in markets by street vendors at public eateries. As sugarcane juice is rich in sugar, it starts fermenting immediately after extraction and also turns brown due to poly phenol oxidease activity (Qudsieh *et al* 2002). Microbial fermentation of the juice turns its taste to sour within few hours of extraction (Yusof *et al* 2000). All these negative changes limit the processing and marketing of sugarcane juice (Eggleston 2002). Development of a preservation method, which can control microbial growth in raw sugarcane juice and maintain its freshness, is a challenging problem for ensuring its wider distribution and availability. Probably, due to this problem, different groups of researchers have tried to preserve different forms of sugarcane juice using membrane technology (micro-filtration and ultra-filtration), chemical preservatives and thermal processing (Singh *et al* 2002, Taylor 2005). The sugarcane juice clarification by micro-filtration and ultra-filtration with chemical are commercial practice adopted by sugar industries as a continuous non thermal process, which result in significant saving in time, material and labour as well as improves yields and quality of product. However, viable technology of sugarcane juice processing at domestic level is not available.

Preservation of pasteurized sugarcane juice by chemical preservative may be an economical process for food industries. This will provide economy in packaging, transportation, storage and distribution of the sugarcane juice. This calls for thorough investigations whether proposed unit operations for the production of sugarcane juice could be replaced by less expensive unit operation. Very meager information is available on above topic; therefore the proposed research work entitled **“Studies on shelf life extension of Sugarcane juice”** has been planned with following objectives.

**Objectives**:-

1. To study the effect of various chemical preservatives on chemical constituents of bottled sugarcane juice during storage.
2. To study the effect of chemical preservatives on shelf life of bottled sugarcane juice at refrigerated and ambient room temperature.

# REVIEW OF LITERATURE

The past experiences are essential to have an introspective view in the research. Keeping this idea hence forth, an attempt has been made in this chapter to present the available review of literature related to the facts of origin, distribution, area, production and utilization of sugarcane, nutritional value of sugarcane juice, technology of preservation sugarcane juice processing and sensory quality of juices and microbiological and storage stability of juices.

## 2.1 Origin, distribution, area, production and utilization of sugarcane

Sugarcane, or sugar cane, are several species of tall perennial true grasses of the genus *Saccharum*, tribe Andropogoneae, native to the warm temperate to tropical regions of South and Southeast Asia, Polynesia and Melanesia, Sugarcane belongs to the grass family Poaceae. The plant is two to six meters (six to twenty feet) tall. It has stout, jointed, fibrous stalks that are rich in the sugar sucrose, which accumulates in the stalk internodes. Sugarcane is the world's largest crop by production quantity, with 1.9 billion tones produced in 2016, and Brazil accounting for 41% of the world total. In 2012, The Food and Agriculture Organization estimated that, it was cultivated on about $26×10^6$ hectares ($6.4×10^7$ acres), in more than 90 countries. The global demand for sugar is the primary driver of sugarcane agriculture. Cane accounts for 80% of sugar produced; most of the rest is made from sugar beets. Sugarcane predominantly grows in the tropical and subtropical regions (sugar beets grow in colder temperate regions). Other than sugar, products derived from sugarcane include falernum, molasses, rum, *cachaça* (a traditional spirit from Brazil), bagasse, and ethanol. In some regions, people use sugarcane reeds to make pens, mats, screens, and thatch. The young, unexpanded inflorescence of Saccharumedule (*duruka* or *tebu telor*) is eaten raw, steamed, or toasted, and prepared in various ways in Southeast Asia, including Fiji and certain island communities of Indonesia.

## 2.2 Nutritional value of sugarcane juice

Consuming sugarcane can be very healthy as it contains a lot of vital ingredients which is ideal for forming a strong immune system. Swaminathan, (1995) reported that sugarcane juice is rich in enzyme and has many medicinal properties. It contains water (75%-85%), reducing sugar (0.3-3.0%), non reducing sugar (10-21%). Sugarcane juice contains 30 grams of natural sugar along with 250 calories. The fat, protein, fiber and cholesterol content is generally less but it contains copious amounts of iron, magnesium, calcium, potassium and sodium. Health Benefits of Sugarcane juice:

**Mentioned below are the best health benefits of Sugarcane juice.**

**1 Can be consumed by diabetic patients too**

Even though diabetic people are not allowed to consume sugar products due to the high sugar content in their blood, sugarcane is relatively safer to consume. Sugarcane contains natural sugar which has extremely low glycemic index, this prevents sudden rise in blood glucose levels in diabetic patients. Sugarcane also acts as a substitute for soft drinks or aerated drinks for these people. However, it should still be consumed in moderation.

2 Helps to prevent cancer from occurring

Sugarcane helps to prevent cancer to some extent. This is because; it is high in alkaline content due to concentration of manganese, iron, potassium, magnesium and calcium. It is difficult for cancer cells to survive in an alkaline environment which is why breast cancer and prostate cancer can be kept at bay by consuming sugarcane juice regularly.

3 Helps in the normal functioning of the kidneys

Sugarcane juice generally boosts the protein levels in the body, thus maintaining the functioning of the kidneys. If it is taken in diluted form along with coconut water and lime juice, it can help to reduce the burning sensation which is associated with prostatitis, kidney stones, sexually transmitted diseases and urinary tract infection (UTI). There are antioxidants present in sugarcane juice which helps to boost the immune system and fight infections in the body. The digestive system also functions smoothly by consuming sugarcane juice.

4 Sugarcane also helps to combat skin conditions

Sugarcane juice has an extremely important component called hydroxy acid and glycolic acid which has plenty of skin benefits. Sugarcane juice can keep the skin hydrated, prevents ageing, reduces blemishes and fights acne. The presence of phenolic compounds, flavonoids and antioxidants can also delay the signs of aging and reduce the appearance of wrinkles. Applying this juice on the face regularly can keep it radiant, soft and supple.

5 Acts as an energy booster

Since sugarcane is a rich source of sucrose (simple sugar), it can be easily absorbed by the body. This sugar can be used to replenish low sugar levels in the body. Therefore, consuming sugarcane juice can make you feeling refreshed, charged and energetic.

6 Helpful during pregnancy

Sugarcane juice is said to be an useful addition to the diet of an expecting mother. It facilitates safer pregnancy and quicker conceptions. Sugarcane has copious amounts of vitamin B9 and folic acid which protects the unborn child from birth defectssuch as Spina bifida. According to studies, sugarcane juice also helps women with ovulating problems, therefore increasing the probability of a safer conception.

7 Prevents tooth decay

Bad breath can be very embarrassing and can also feel very uncomfortable. Sugarcane can be used as a home remedy to combat this problem. Sugarcane contains important minerals like phosphorous and calcium which helps to build up the teeth enamel, thus keeping tooth decay at bay.

8 Treats ferbile disorders

Ferbile disorders are very common in kids or early teens. It can cause regular fevers with extremely high temperature. During the fever, a lot of protein content is lost. Sugarcane juice helps to replenish the lost proteins and helps in speedy recovery from the fever.

9 Helps lose weight

Sugarcane is ideal for people who want to reduce weight, since it has natural sugar, Sugarcane juice can also reduce unhealthy cholesterol levels. It is high in soluble fibre which is why it can reduce weight drastically. Sugarcane is ideal for a sore throat and increases muscle power as it contains natural glucose which is required by the body to maintain stamina. In many cases, jaundice or yellow fever can also be cured by consuming sugarcane juice. Sugarcane can also be used to manufacture recycled paper, this helps to reduce deforestation to a great extent. The side effects of consuming sugarcane juice is extremely low, but however it can lead to some health issues. An ingredient called policosanol present in sugarcane can cause insomnia, upset stomach, dizziness, headaches and weight loss if consumed excessively. It can also cause blood thinning and can affect the cholesterol levels in the blood.

## 2.3 Preservation of sugarcane juice

Sugarcane juice is one of the delicious drinks that enjoy a wide popularity in view of its pleasing taste, refreshing tingle and availability during the greater part of the year throughout the country. The main problem associated with fresh sugarcane juice is its short life and heat sensitivity of its flavor. Therefore the drink is mostly sold – fresh by roadsides and small eateries. Therefore, most of the attempts to preserve the sugarcane juice have been focusing on the use of refrigeration, heat treatment and preservatives.

Kapur et al. (1978) reported, that the freshly crushed cane juice heated to $80^0$C, mixed with citric acid (0.2%) alone or in combination with ascorbic acid (0.05%) Filtered, filled hot in to sterilized bottles and sealed immediately, maintained the original taste and flavor of sugarcane juice.

Bobadilla and Preston, (1981).reported that sodium benzoate at a concentration of 0.05%was sufficient to stop fermentation sugarcane juice for 2 – 3 days and 0.1% was enough to preserve the juice for 6days. On the other hand aqueous ammonia at a concentration of 0.32% preserved the juice for 2 days and 1.28% upto 6 days

Attempts made to preserve the sugarcane juice involved blanching of stems, juice extraction, pasteurization followed by addition of ascorbic or citric acid and preservatives such as potassium meta bisulphate, sulphur dioxide and bromo nitro propanediol. Ginger or lemon extract were added to improve the taste. The juice thus prepared was bottled in sterilized glass bottles to be used as an acceptable beverage with a low shelf life under room temperature at refrigerated condition (Anonymous 1991; Mann and Singh 1988)

Bhupinder et al. (1991) developed a process for preservation of sugarcane juice into acceptable ready to serve beverage by pasteurization of sugarcane juice for 10 min at $80^0$C with addition of preservative 140 ppm potassium meta bi sulphite.

Nicolas et al, (1994) reported the variations in the effect of different acids on enzymes activity; as an example, malic acid and citric acid has been reported to be more efficient in the inhibitor of enzyme activity in sugarcane juice.

Whitaker 1994 and Lin et al.,(2007). Reported that ascorbic acid is the most widely used inhibitors of enzymes activity in addition to its reducing properties and lowering pH

Kaur et al. (1995) reported that, addition of preservatives and sterilization increased the shelf life of sugarcane juice up to 24 weeks.

Kaur *et al.* (1995) reported the scheme for producing bottled cane juice by pasteurizing the extracted juice for 10 min at $80^0$ C, adding $K_2S_2O_5$ equivalent to 70 ppm. $SO_2$ hot bottling, sterilizing for 30 min at $100^0$C and cooling for storage and reported that *Leuconostoc mesenteroides* activity was absent from both plain and treated juices.

Khanna (1995) reported the use of Deola (Hibiscus esculentus) extract for cane juice clarification. The extract was added to the boiling pan in three installments (10:10:5) with an interval of 5-10 minutes result in clear, transparent and light brownish yellow colour juice.

Yusof *et al*. (1999) studied the quality of sugar-cane juice extracted from stored canes, as well as changes in quality of fresh juice stored at different temperatures and reported that low temperature storage of canes was able to maintain the quality of juice for up to 9 days .During storage, sucrose contents decreased while fructose, glucose and titratable acidity increased in the samples.

Chauhan et al., (2002) reported that during storage of sugarcane juice the pH, total soluble solids and total sugars decreased, whereas, titratable acidity and reducing sugars increased significantly ($P<0.01$).

Hanan *et al*. (2002) studied the effect of sugarcane maturation on the contents of chlorophyll, tannin, and polyphenol oxidase (PPO) activity and on color change of sugarcane juice and reported that there were significant decreases in total chlorophyll a and b and tannin contents during maturity followed by slower rates of decrease of both parameters at the end of maturity stages. There was a highly significant difference in PPO activity of cane juice during maturity. PPO activity was high at the early development stage, decreased during maturation, and then remained relatively constant at the end of maturity.

Prasad and Nath, (2002) reported the quality of sugarcane juice extracted from stored canes, as well as changes in quality of fresh juice stored at different temperatures.

Pushpa et al. (2002) reported the process for the preparation of sugarcane juice concentrate using citric acid alone and in combination with sodium benzoate. Treated samples were packed in glass bottles shows that concentrate when treated with citric acid (0.5%) and sodium benzoate (500 ppm) in combination gives the best result in terms of appearance, clarity, colour, flavour, taste and shelf life was increased upto 8 months.

Bosse et al. (2006) preserved sugarcane juice by heating it to a different temperature (75, 85 and 95$^0$C) with addition of potassium meta bi sulphite and citric acid and observed decrease in pH at elevated time and temperature of pasteurization. The reducing sugars showed an upward trend as the temperature of pasteurization increased and sucrose levels decreased.

Lin Chun Mao et al. (2007) reported that the combination of blanching of sugarcane stems and addition of ascorbic acid produce the best quality of sugarcane juice.

Mao et al. (2007) reported the physiochemical changes in fresh sugarcane juice stored at 10˚C. It was seen that blanching of stems before squeezing the juice and use of ascorbic acid (0.1%) improved the quality of sugarcane juice by preventing degreening and/or browning, and reduced activities of PPO (polyphenol oxidase) and SNI (sugarcane neutral invertase) in fresh sugarcane juice. Addition of ascorbic acid appeared to be more effective than blanching.

Azra Yasmin et al. (2010) reported that sugarcane juice pasteurized just after extraction and its pH was maintained at 4.3 by the addition of citric acid, hot filled in sterilized glass bottles, stored at room temperature for four months. The developed product had attractive color, flavor and refreshing with uniform consistency. Bottled juice samples were merely accepted up to a storage period of 120 days

Karmakar *et al*. (2011) prepared sugarcane juice beverage by pasteurizing 100 ml of sugarcane juice at 80, 85, 90, 95 $^{0}$C for 2 min and stored at 25 and 40 C in glass bottles and reported that an acceptable quality beverage of sugarcane juice with satisfactory storage stability for 25 days at 40 $^{0}$C could be prepared.

.Mishra et al. (2011) analyzed that a combination of gamma radiation (5 kGy) with permitted preservatives and low temperature storage (10$^{0}$C) could preserve raw sugarcane juice for more than a month. The preservatives used were citric acid (0.3%), sodium benzoate (0.015%), potassium sorbate (0.025%), and sucrose (10%). The treatment helped in extending the shelf life to 15 days at ambient temperature (26± 2$^{0}$C) and 35 days at 10$^{0}$C.

Krishna *et al.* (2013) determined the quality of sugarcane juice extracted from stored canes, as well as changes in quality of fresh juice stored at different temperatures and reported that low temperature storage (10$^{0}$C) of canes was able to maintain the quality of juice for 10 days, while low temperature storage (5$^{0}$C) of juice could last for only 4 days. Spoilage of cane stored at 30$^{0}$C occurred faster than that stored at 10$^{0}$C. Fresh sugarcane juice became spoil within a day when stored at 30$^{0}$ C. Microbial count (bacteria, yeast, fungi) especially lactic acid bacteria count increased, during storage of cane juice.

## 2.4 Processing and sensory quality of juices:

Lionnet, (1986) reported that rate at which harvested cane deteriorates is influenced primarily by temperature, humidity, cane variety and the state of the stalk.

Goyle and Ojha, (1998).reported the sensory quality of preserved orange juice with potassium metabisulphite and stored at refrigerated temperature (1°C) and at room temperature for a period of 4 weeks. On sensory evaluation scores for flavour, acceptability and taste of experimental juice and a control were comparable during first three weeks. In 4th week the sweet and after taste was found to be considerably lower.

Orange juice was stored at refrigerated temperature without preservative and at room temperature with preservative for a period of 4 weeks. At refrigerated temperature there was decrease in pH and titrable acidity. But there was no change in pH and titrable acidity (TA) at room temperature. The storage of orange juice brought about a loss of 5-8% vitamin C at refrigerated and room temperatures after 4 weeks (Goyle and Ojha, 1998).

Litchi juice was extracted from ripe litchi fruits. The extracted juice was subjected to different treatments: T1 = heating at 850 C + citric acid (1%) + KMS (500 ppm); T2 = citric acid (1%) + KMS (500 ppm); T3 = heating at 85 degrees C + citric acid (1%) + ascorbic acid (0.01%) + KMS (500 ppm); and T4 = citric acid (1%) + ascorbic acid (0.01%) + KMS (500 ppm). The processed juice samples were kept in glass bottles sealed with crown corks and stored for 12 months at 11-360C (room temperature) and at 5-80C (low temperature). Results showed that bottled litchi juice maintained acceptable colour and quality for up to 12 months when stored at low temperature and only up to 6 months for T1 and T3 samples stored at room temperature (Alex et al., 2003).

The chemical, enzymatic changes and shelf life of pasteurized orange juice packed in polyethylene teraphthalate bottles stored at $4^0$C were evaluated. Two batches of orange juice samples were pasteurized at $72^0$ C for 16 seconds and at $90^0$C for 40 seconds. The orange juice samples were evaluated periodically for relative density, soluble solids (degrees Brix), titrable acidity, pH, suspended solids (pulp), ascorbic acid, colour, and pectin esterase activity. The juice samples exhibited good stability and no statistical difference was observed among the treatments, except for colour (turbidity) that increased with longer storage time (Correo et al., 2003).

Unpasteurized and pasteurized sweet orange juices were filled in sterilized and unsterilized bottles, stored at room temperature and refrigerated temperature. Visual appearance of all the juice samples was maintained within highly acceptable range during the entire period of storage but with the advancement of time, deterioration in taste and flavor occurred which adversely affected the overall acceptability of juice samples (Jain et al., 2003).

A study was done to develop a low cost method of lime juice preservation. Pasteurized (77$^0$C for 60 seconds) and non-pasteurized juice were treated with different levels of potassium metabisulfite (500 ppm, 1000 ppm, 1500 ppm and 2000 ppm) and stored in glass bottles at room temperature for 3 months. Results obtained showed that total soluble solids increased during storage while sulfur dioxide (SO2) and ascorbic acid contents gradually decreased. Non-pasteurized juice was found to be the most acceptable in terms of organoleptic evaluation. It was found that lime juice could be preserved for a period of about 10 weeks without any undesirable changes by using $SO_2$ at an initial level of 500 ppm (Ekanayake et al., 2004).

Falade et al., (2004) reported that, sweetened mango juices processed, bottled and stored at 25 °C for 12 weeks. The titrable acidity, pH, total solids, ash, soluble solids and ascorbic acid contents were evaluated immediately after processing and subsequently at 2-week intervals. The quality attributes of the sweetened mango juices decreased during storage. After 12 weeks of storage, the percentage ascorbic acid loss of sweetened Julie and Ogbomoso mango juices was 16.25 and 16.67%, respectively. Browning index increased during storage.

Shelf life of Passion Fruit Juice was increased using sugar, benzoic acid, citric acid and a combination of citric and benzoic acid. The result showed that 30% benzoic acid was able to preserve the juice for one month and was found to be the best method .The juice with 4% sugar was spoiled after three days, while that of 4% citric acid could be stored for one week and some days. The combination of 3% benzoic acid and 4% citric acid increased the shelf life upto two to three weeks (Akpan and Kovo, 2005).

Madsen et al. (2005) reported work on preservation of sugarcane juice using mixed dithiocarbamates. The study focused on use of mixtures containing methyldithiocarbamic acid sodium (Vapam) and ethylenebis (dithiocarbamic acid) disodium salt (Nabam) on sugarcane juice. Biocides were applied at levels ranging from 5 to 20 mg/kg. It was shown that biocide applied at levels greater than 5 mg/kg could preserve sugar cane juice.

A study was done by Zanoni, et al (2005) to examine the quality and shelf-life of freshly squeezed, unpasteurized blonde and blood orange juice from organic farming methods. Thermal treatment had an effect on nutritional and sensory quality of blonde orange juice. Shelf-life studies revealed that unpasteurized juices could be stored at approximately $10^0$C for 10 days without significant growth of spoilage microorganisms. However decrease in ascorbic acid and anthocyanin content was observed during storage.

A study was done to determine the most suitable combination of preservative (sodium benzoate) and pasteurization levels for the preservation of pomegranate juice at room temperature. After extraction, the juice was submitted to various levels of pasteurization (i.e., no pasteurization, 60°C, 70°C and 80°C) and sodium benzoate treatment (i.e., 0, 400, 500 and 600 ppm). In juice samples treated with both pasteurization at 70°C and sodium benzoate at 500 ppm minimum changes were observed in all physicochemical parameters (Suryawanshi et al., 2008).

Grape juice was studied for one month at room temperature, after adding sodium benzoate and potassium sorbate (treatment T1: 0.1% sodium benzoate, T2: 0.2% potassium sorbate, T3: 0.1% sodium benzoate + 0.2% potassium sorbate, T4: control). Stability of ascorbic acid was found to be highest in T3, followed by T1, T2, and T4. Acidity and total soluble solids increased during storage. T1 obtained maximum score (8.0) for overall acceptability. T1 was found to be better for preserving nutritive and sensory values of the grape juice (Alam et al., 2009).

## 2.5 Microbiological and storage stability of juices

Hassandar et al. (1992) reported that heat treatment reduced the overall microbial load by 96.0 – 93.3% without any detrimental effect on physico-chemical characteristics of the juice.

Raw sugarcane juice was found to have $2.7x10^6$ bacterial colonies per ml and $4.8x10^5$ yeast and mould count per ml of sample. E coli count was found to be $4.99x10^4$cfu/ml (Nagalakshmi, 1995).

Chauhan et al. (2002) reported that microbiological population (total plate counts, and yeast and mold counts) increased during storage of sugarcane juice. The extent of increase in microbial population was also higher at room temperature as compared to refrigeration temperature. Highest counts were obtained during storage of pasteurized juice followed by pasteurization with addition of ascorbic acid followed by pasteurization with addition of citric acid. Addition of potassium metabisulphite to juice further reduced the counts appreciably. Raw sugarcane juice had 10 to 20 colonies of coliforms per 10 ml. The coliforms disappeared after pasteurization and no coliform could be detected throughout the storage.

Foley et al., (2002) reported that irradiation was less effective in reducing the yeast and mould population. The lower dose of 0.7 and 1.4 kGy had a minimal effect: while 3.5 and 4.0 kGy reduced the population by over 1 logs in fresh orange juice.

Oliveira et al., (2006) reported that fresh sugarcane juice sold by street vendors without any heat treatment showed thermo tolerant coliform levels were higher than allowed by Brazilian standards. Salmonella spp. and parasites were absent in all samples.

Solomon *et al.,* (2006), reported the sugarcane juice deterioration products including high invert sugars, polysaccharides (*e.g.* Dextran) and microbial contamination (e.g., ethanol and lactic acid formation) at the factory level.

Frazier and Westhoff, ( 2007) reported that sugarcane juice is widely spoiled by bacteria such as, Leuconostoc, Enterobacter, Flavobacteruim, Micrococcus, Lactobacillus, Actinomyces. Among yeast and molds, Aspergillus, Cladosporium, Monilla, Penicillium, Saccharomyces, Candidia, Pichia, Torulopsis are responsible for spoilage.

Subbannayya et al. (2007) reported that heat treatment reduces bacterial count in juice ranged from 105 to 107cfu/ml. Salmonella, Shigella and Vibrios were not present. However presence of E.coli, other coliforms and Enterococci indicated faecal contamination of juice.

Solomon, (2009) reported that sugarcane juice is highly fermentable, it contains about 15-18% sucrose, 0.5% reducing sugars and adequate amount of organic nitrogen and mineral salts for microbial growth. Its pH ranges from 5.0-5.5 making it selective for acidophilic microorganism especially yeast and lactic acid bacteria. Large population of yeast favors the ethanol production at the expense of sucrose. The microbial contamination of the juice is usually extremely high, typical viable counts being 108-109 cells/ml of juice. The major loss of sugar occurs due to inversion of sucrose in raw sugar cane juice and other types of degradation of the juice caused by bacterial activities, enzymes and other biological factors moreover spoilage depends on the type of cane used for juice extraction.

Tambekar et al. (2009) reported that out of 52 fruit juice samples analyzed in Amravati city, India, for presence of enteric bacterial pathogens. The dominant bacterial pathogen present in juices were *Escherichia coli* (40%), followed by *Pseudomonas aeruginosa* (25%), *Salmonella spp*. (16%), *Proteus spp*. (9%), *Staphylococcus aureus* (6%), *Klebsiella spp*. (3%) and *Enterobacter spp*. (1%). The highest bacterial contamination was observed in sweet lemon juice (35%), pineapple (29%), pomegranate, apple and orange (12%) each.

Similar study was done in Nagpur city where fruit and vegetable juice samples were analyzed for their microbiological quality. A total of 38 samples were analyzed for total viable count, total and fecal coliforms, staphylococci on mannitolsalt agar and salmonella. The total viable count in all the fruit and vegetable samples were in the range of $2.0x10^4$– $4.6x10^6$. Almost 50% of the fruit and vegetable juices also showed the presence of Salmonella (Titarmare et al., 2009).

From the preceding paragraphs, it can be reduced that the systematic information on the object of the present proposed programme of study is still quite meagre. However, there are tremendous opportunities to work for diversified uses at home and commercial scale. Therefore, the present investigation has been undertaken to provide the relevant knowledge in the selected field of study.

# MATERIALS AND METHODS

This chapter deals with the various experimental techniques, materials and methodologies used to conduct studies on shelf life extension of sugarcane juice. The present research work was carried out in the Department of Food Science and Technology, College of Agriculture, Jawaharlal Nehru Krishi, Vishwa Vidyalaya, Jabalpur (M.P.) during the year 2017-2018.

## 3.1 Experimental materials

The freshly harvested, sugarcanes were procured from Jawaharlal Nehru Krishi Vishwa Vidyalaya research farm. The glass bottles were purchased from Priya Darshani Co-operative Store, Civic Centre, Jabalpur. All the chemicals used in present investigation were of standard analytical grades from BDH (India), E-Merck and Sarabhai, M. Company. The glassware's used in the present investigation were from Qualigens and Borosil Company respectively.

### 3.1.3 Equipments and machines

Following equipments and machines were used for conducting experiment.

| S. No. | Name of equipment/machine | Source of supply |
|---|---|---|
| 1. | Sugarcane juice extractor/ crusher | M/s D.K. Berry & Co. Pvt. Ltd. 11/35, West Punjabi Bagh, New Delhi, India |
| 2. | Autoclave | M/S Ambica Sons Near marbel city Hospital Jabalpur |
| 3 | Referagerator | M/s Blue Star Ltd. Block-2A DLF corporate park DLF Qutab Enclave, Phase 3, Gurgaon, Haryana |
| 4 | juice and water analysis testing kit, model 191 E Delux | M/s Environmental and Scientific Instruments Corporation, Panchkula, Haryana, India |
| 5 | Hand refrecto meter (ERMA) | M/s D.K. Berry & Co. (P) Ltd. 11/35 West Punjabi Bagh, New Delhi, India |
| 6 | Electronic balance TS 2005 | M/s DHAUS Corporation, Made in USA |

| | | |
|---|---|---|
| 7 | Citizen electronic balance | M/s Citizen scale (I) Pvt. Ltd. Daora (UT & DNN) |
| 8 | Sensory Evaluation Lab | Godrej Industries Limited. Pirojshanagar, Eastern Express Highway, Vikhroli, Mumbai-400079, India |
| 9 | Colorimeter spectronic-20 | Bausch and Lomb (Pvt.) Ltd. |
| 10 | Utensils for handling and storage S.S. trays, glass jar, plastic Basket and bucket | M/s D.K. Berry & Co. (P) Ltd. 11/35 West Punjabi Bagh New Delhi.<br>M/s J.K. Sales & promoters<br>Gole Bazar, Write Town, Jabalpur (M.P.) |

## 3.2 Experimental methods

### 3.2.1 Experimental plan and design

In accordance with the objectives of investigation the experiment was conducted in Complete Randomized Design (CRD) with three replications the details of treatment combinations are presented in Table 3.1

**Table 3.1: Treatment combination of experiments to study effect of preservatives and pasteurization temperature for extension of shelf life of sugarcane juice**

| SNo | Treatment | Description |
|---|---|---|
| 1 | $CA_1T_1$ | 0.02 % Citric acid and 60 $^0$C Pasteurization |
| 2 | $CA_2T_1$ | 0.04 % Citric acid and 60 $^0$C Pasteurization |
| 3 | $CA_3T_1$ | 0.06 % Citric acid and 60 $^0$C Pasteurization |
| 4 | $CA_1T_2$ | 0.02 % Citric acid and 70 $^0$C Pasteurization |
| 5 | $CA_2T_2$ | 0.04 % Citric acid and 70 $^0$C Pasteurization |
| 6 | $CA_3T_2$ | 0.06 % Citric acid and 70 $^0$C Pasteurization |
| 7 | $CA_1T_3$ | 0.02 % Citric acid and 80 $^0$C Pasteurization |
| 8 | $CA_2T_3$ | 0.04 % Citric acid and 80 $^0$C Pasteurization |
| 9 | $CA_3T_3$ | 0.06 % Citric acid and 80 $^0$C Pasteurization |
| 10 | $KMS_1T_1$ | 0.25 ppm Potassium metabisulphite and 60 $^0$C Pasteurization |

| | | |
|---|---|---|
| 11 | $KMS_2T_1$ | 0. 5 ppm Potassium meta bi sulphite and 60 $^0$C Pasteurization |
| 12 | $KMS_3T_1$ | 0.75 ppm Potassium meta bi sulphite and 60 $^0$C Pasteurization |
| 13 | $KMS_1T_2$ | 0.25 ppm Potassium meta bi sulphite and 70 $^0$C Pasteurization |
| 14 | $KMS_2T_2$ | 0. 5 ppm Potassium meta bi sulphite and 70 $^0$C Pasteurization |
| 15 | $KMS_3T_2$ | 0.75 ppm Potassium meta bi sulphite and 70 $^0$C Pasteurization |
| 16 | $KMS_1T_3$ | 0.25 ppm Potassium meta bi sulphite and 80 $^0$C Pasteurization |
| 17 | $KMS_2T_3$ | 0. 5 ppm Potassium meta bi sulphite and 80 $^0$C Pasteurization |
| 18 | $KMS_3T_3$ | 0.75 ppm Potassium meta bi sulphite and 80 $^0$C Pasteurization |
| 19 | $PS_1T_1$ | 0.15 % Potassium sorbate and 60 $^0$C Pasteurization |
| 20 | $PS_2T_1$ | 0.25 % Potassium sorbate and 60 $^0$C Pasteurization |
| 21 | $PS_3T_1$ | 0. 5 % Potassium sorbate and 60 $^0$C Pasteurization |
| 22 | $PS_1T_2$ | 0.15 % Potassium sorbate and 70 $^0$C Pasteurization |
| 23 | $PS_2T_2$ | 0.25 % Potassium sorbate and 70 $^0$C Pasteurization |
| 24 | $PS_3T_2$ | 0. 5 % Potassium sorbate and 70 $^0$C Pasteurization |
| 25 | $PS_1T_3$ | 0.15 % Potassium sorbate and 80 $^0$C Pasteurization |
| 26 | $PS_2T_3$ | 0.25 % Potassium sorbate and 80 $^0$C Pasteurization |
| 27 | $PS_3T_3$ | 0. 5 % Potassium sorbate and 80 $^0$C Pasteurization |
| 28 | $AA_1T_1$ | 0.02 % Ascorbic acid and 60 $^0$C Pasteurization |
| 29 | $AA_2T_1$ | 0.04 % Ascorbic acid and 60 $^0$C Pasteurization |
| 30 | $AA_3T_1$ | 0.06 % Ascorbic acid and 60 $^0$C Pasteurization |
| 31 | $AA_1T_2$ | 0.02 % Ascorbic acid and 70 $^0$C Pasteurization |
| 32 | $AA_2T_2$ | 0.04 % Ascorbic acid and 70 $^0$C Pasteurization |
| 33 | $AA_3T_2$ | 0.06 % Ascorbic acid and 70 $^0$C Pasteurization |
| 34 | $AA_1T_3$ | 0.02 % Ascorbic acid and 80 $^0$C Pasteurization |
| 35 | $AA_2T_3$ | 0.04 % Ascorbic acid and 80 $^0$C Pasteurization |
| 36 | $AA_3T_3$ | 0.06 % Ascorbic acid and 80 $^0$C Pasteurization |

### 3.2.2 Processing of sugarcane juice for storage study

The fresh sugarcane juice was obtained after crushing sugarcanes using commercial sugarcane crusher. The juice was filtered and immediately bulk packed in 10 lit capacity glass bottles for further use in experiments as per experimental plan (Table 3.1). The glass bottles used for storage study were thoroughly cleaned with warm water to remove adhering dust and dirt etc. The bottles were sterilized in autoclave at 15 psi ($121^0$C) for 15 min according to procedure as described by Ranganna (1986). The sugarcane juice was also pasteurized separately and treated with different concentration of preservatives as per experiment plan and filled in 200 ml capacity pre sterilized bottle, corked, stored at refrigerated condition ($5^0$C) and at ambient room temperature ($31^0$C) for 07,14, and 21 days.

### 3.3 Analytical Methods

The following methods were used for various determinations.

### 3.3.1 Chemical composition

#### 3.3.1.1 Moisture

The moisture content in the sample was estimated according to the method of AOAC (1984).

The sample (5g) was taken in pre-weighed moisture box, dried at 105ºC for 24hr in hot air oven, cooled in dessicator and weighed. The difference in weight of moisture box represents the moisture content of the sample.

**Calculation**

$$\text{Moisture (\%)} = \frac{\text{Difference in weight}}{\text{Weight of sample}} \times 100$$

#### 3.3.1.2 Carbohydrates

Total carbohydrates in the samples were estimated by hydrolysis method as described in AOAC (1984).

**Reagents:**

1. Conc. HCl (AR sp.gr.1.25).

2. Fehling's solution:

Fehling's solution A: 34.64g of $CuSO_4.5H_2O$ was dissolved in 500ml of distilled water.

Fehling's solution B: 173g of sodium potassium tartarate and 50g of sodium hydroxide were dissolved in 500ml of distilled water. The Fehling's solution was prepared by mixing the equal volume of solution A and solution B. It was prepared fresh daily.

3. Sodium hydroxide solution: 40% (w/v).

4. Methyl blue indicator: 0.1% (w/v) in 95% alcohol.

5. 3N HCl-68.18ml concentrated HCl was made up to 250ml with distilled water.

6. Dextrose 1% - 1g of dextrose was dissolved in 100ml distilled water.

**Procedure**

The sample (2.5g) was taken in the flask and suspended in 200ml of distilled water. Twenty ml of 3NHCl was added and refluxed in an air condenser for 3hr. On cooling, it was neutralized with alkali to pH 7.0, filtered and volume was made to 250ml with distilled water.

The total carbohydrates in the filtrate were determined by titrating it with Fehling's solution (A & B, 5ml each) using 1ml of methyl blue indicator. Factor was worked out by titrating 1% dextrose with Fehling's solution. In each titration Fehling's solution in the conical flask was heated with a constant flame and titration was done with filtrate in the burette until the end point (brick-red colour) was obtained. The total carbohydrate content was calculated as under.

**Calculation**

$$\text{Factor} = \frac{\text{Titre value x 2.5}}{1000}$$

$$\text{Dextrose \%} = \frac{\text{Factor x 250}}{\text{Titrated value x Weight of sample}} \times 100$$

$$\text{Total carbohydrates (\%)} = \text{Dextrose \% x 0.9}$$

**3.3.1.3 Ash**

The ash content in the sample was determined by procedure as describe in AOAC (1984). The sample (5g) was placed in pre-weighed crucible. It was burned on gas flame until it was completely charred. The samples were then placed in muffle furnace for combustion at 520°C for 5hr; their-after samples were cooled in desiccators and weighed. The heating in muffle furnace was repeated until constant weight was obtained. The ash content was calculated as under.

**Calculation**

$$\text{Ash (\%)} = \frac{\text{Initial weight of empty crucible and sample} - \text{Final weight of crucible with ash}}{\text{Weight of sample}} \times 100$$

**3.3.1.4 Sugar**

The sugars content of the sample was determined by the procedure as described by Ranganna (1991).

**Reagents:**

1. Fehling's solution A.
2. Fehling's solution B.
3. Methylene blue indicator.
4. 45% Neutral Lead Acetate solution: 225gm of neutral lead acetate were dissolved in distilled water and diluted to 500ml.

5. 22% Potassium Oxalate solution: 110 gm of potassium oxalate ($K_2C_2O_4.H_2O$) were dissolved in distilled water and make upto 500ml.

6. Standard invert sugar solution:

Weighed 9.5g of AR grade sucrose into 1 litre volumetric flask. Then added 100ml water and 5ml concentrated HCl. Allowed it to stand for 3 days at 20-25$^{o}$C for inversion to take place and then make up to mark with water and its stable for several days. Pipette 25ml of standard invert sugar solution into 100ml volumetric flask and added 50ml water. Added few drops of phenolphthalein indicator and neutralized with 20% NaOH until pink. Then it was acidified with 1N HCl by adding it drop wise until 1 drop causes the pink to disappear. Make unto mark with water (1ml=2.5mg of invert sugar).

7. Standardization of Fehling's solution:

Mix 50ml solutions of Fehling A and 50ml of Fehling B. Pipette 10ml of mixed solution into 250ml conical flask and added 25ml water. Take invert sugar solution prepared by inversion of sucrose in 50ml burette. Add to the mixed Fehling solution almost the whole of the standard invert sugar solution (18-19ml) required to effect the reduction of copper, so that not more than 1ml will required to complete titration. The flask was heat over a hot plate covered with asbestos filled wire gauze. When liquid began to boil, keep in moderate ebullition for 2min.On flame, added three drop of methylene blue and completed titration in 1min, over all 3 min and no interruption. End point were noted which was indicated by the discoloration of indicator (i.e. brick red).

$$\text{Factor for Fehling's solution (g of invert sugar)} = \frac{\text{Titre value x 2.5}}{1000}$$

**Preparation of sample:**

25g of sample powder was taken and transferred to 250ml flask. Added 100ml water and neutralized with 1NNaOH and then filtered. 2ml of lead acetate solution was added, shaked well and allowed it to stand for 10 min. Added 2ml of potassium oxalate solution to remove excess lead and make up the volume with water and filtered.

**(A) Reducing sugar**

Pipette 10ml of mixed Fehling solution into 250ml conical flask (5A and 5B). The burette was filled with the sample solution prepared. Then run into the flask almost the whole volume(15-50ml) of solution required to reduce the Fehling solution so that 0.5-1.0ml is require to later complete titration. Mixed the content and was heated to boiling and boiled moderately for 2min.Then added 3 drops of methylene blue and by not touching the sides. Titration was completed within 1min by adding 2-3 drops of sugar solution at 5-10sec intervals, until the indicator is completely decolourized from blue to brick red of cuprous oxide. Noted the volume of the solution required.

**Note:** End point was determined within 1 drop of sugar and not interrupting the boiling more than few seconds as the indicator undergoes back oxidation rapidly when air has free excess into the flask.

**Calculation**

$$\text{Reducing sugar \%} = \frac{\text{Factor x Dilution x 100}}{\text{Titer value x Weight of sample}}$$

**(B) Total sugar**

50ml of the clarified solution was pipette into 250ml flask and added 5g of citric acid and 50ml of water. It was boiled gently for 10 min to complete inversion of sucrose, and then cooled. Transferred it to 250ml flask and neutralized with 1NNaOH using phenolphthalein and make up volume and was titrated with Fehling solution.

**Calculation:**

$$\text{Total sugar \%} = \frac{\text{Factor x Dilution x 100}}{\text{Titer value x Weight of sample}}$$

Non reducing sugar % = Total sugar - Reducing sugar

#### 3.3.1.5 Total soluble solids

The Total soluble solids (TSS) were measured with the standerd methods of A.O.A.C. (2005), by Atago digital refractometer at room temperature. To calibrate the instrument, distilled water and test solution of known sucrose concentration was used. After each reading, a clean soft lint free material was used to clean the refractometer. A drop of sugarcane juice (Treated with chemical and fresh) sample kept onto the dry prism of refractometer, and readings were taken in ° brix, factors related to temperature was also added or removal of errors.

#### 3.3.1.6 Acidity

Titrable acidity content of samples was determined by simple acid-alkaline titration method as described in AOAC (1984). The samples were homogenized with 100ml distilled water. Now 25ml of diluted sample was transferred into a 250ml beaker. Three drops of phenolphthalein indicator was added to the solution. N/10 NaOH solution was taken in burette and titrated with alkali solution drop by drop with constant stirring till the pink end point is reached. End point readings were recorded and the percentage acidity was calculated in terms of citric acid by the following formula.

**Calculation**

$$\text{T.A.\%} = \frac{\text{Reading x Normality of NaOH x Equivalent weight of Citric acid}}{\text{Volume of sample taken x 1000}} \text{x 100}$$

#### 3.3.1.7 Total Phenol

The total phenol content of samples was determined by procedure as described by Sadasivam and Manickam (1991).

**Reagents:**

1. 80% ethanol: (80ml ethanol + 20ml distilled water).

2. Folin - ciocalteau reagent.

3. 20% sodium carbonate ($Na_2Co_3$).

4. Standard - (100mg catechol in 100ml distilled water), dilute 10 times for a working standard.

5. Blank - (3ml distilled water + 0.5ml Folin reagent + 2ml $Na_2Co_3$).

**Procedure**

The sample (0.5 to 1.0g) was grind in pestle and mortar in 10 time volume of 80% ethanol. The aliquot was centrifuge and homogenized at 10,000 RPM for 20 min. The supernatant collected and residue was re-extracted five times with 80% ethanol. The supernatant was pooled and evaporated to dryness. The dried residue was further dissolved in a known volume of distilled water (5 to 10 ml). Form the above solution pipette out aliquots, 0.2ml into 20ml test tube. Now make up the volume in each test tube upto 3ml with distilled water (add 2.8ml distilled water). 3ml of folin reagent was taken and its volume was makeup to 9ml. From this solution add 0.5ml of folin reagent in to the test tube. After a period of 3 min, add 2ml of 20% $Na_2Co_3$ solution to each tube. Mix it thoroughly and place the tubes in boiling water for exactly 1 min. Cool it and measure the absorbance at 650 nm against a reagent blank. Also prepare a standard curve simultaneously using different concentration of catechol.

The phenol content was calculated from the standard curve prepared by catechol and express as mg of phenol/100g sample.

**Calculation**

$$\frac{\text{Concentration of std.}}{\text{Absorbance of std.}} \times \frac{\text{Abs.of sample}}{\text{Vol.of assay}} \times \frac{\text{Vol.make up}}{\text{Wt.of sample}} \times 100$$

**3.3.1.8 Polyphenol oxidase (PPO) activity**

Polyphenol oxidase (PPO) was determination according to the methods described by Zugustin M.A. and Ghazil H.M. (1985).

**Reagents**

1. Chilled acetone
2. 0.2M Potassium phosphate buffer, pH 6.8
3. 0.05M Catechol : Prepare in 0.2M phosphate buffer, pH 6.8

**Method**

For the PPO activity, the phosphate buffer (pH 6.0) and catecol were added to an aliquot of the sample and incubated at $30^0$C for 30 min. The reaction was then terminated with perchloric acid the absorbance was read in a spectrophotometer at 395 nm. A blank absorbance of sugarcane juice added to the phosphate buffer solution (Subsitute for the reagents) was determined

Enzyme activity was expressed In U/mL with one unit equivalent to variation of 0.001 absorbance per min. per mL of sample. The eq. $1^{st}$ was applied to calculate the enzyme activity.

$$\text{Activity (U/ml)} = \frac{(Ab_{\,sample} - Ab_{\,blank})}{0.001 \text{ X } t}$$

Where Ab sample is the sample absorbance; AB blank is the blank absorbance; and t the incubation time of sample with reagents (min.)

### 3.3.2 Microbiological analysis of sugarcane juice

#### 3.3.2.1 Total Plate Count

The total plate count in stored sugarcane juice was determined by following the standard procedure as described by Ranganna (1986)

### 3.4.3 Sensory evaluation of stored sugarcane juice

A semi trained panel of 10 members was given samples of fresh and stored sugarcane juice to evaluate the sensory quality attributes viz.; colour/appearance, taste, flavor and overall acceptability. The evaluation of sensory attributes was carried out according to the method of Amerine *et al.* (1965) on 9 point hedonic scale as given in Appendix- I.

### 3.5 Statistical analysis of data

The experiment was conducted in complete randomized design (CRD) using WASP, Version 1.0 (http://icargoa.res.in/wasp). The data was subjected to one-way analysis of variance (ANOVA) at 5% level of significance. The skeleton of ANOVA for complete randomized design (CRD) is presented in table given below:

**Skeleton of Analysis of variance**

| Source of variation | d.f. | S.S. | M.S.S. | F cal. | F tabulated | Value at |
|---|---|---|---|---|---|---|
| | | | | | 5% | 1% |
| Treatments | t-1 (24) | SSt | MSSt | MSSt/MSSe | | |
| Error | n-t (25) | SSe | MSSe | | | |
| Total | n-1 (49) | | | | | |

n = Total number of observations

t = Number of treatments

The 'F' test was applied to check the overall significance of various treatments in general and comparison of individual treatment was made with the help of critical difference at 5% level of significance, which was calculated as given below:

$$\text{SEm}\pm \text{for treatment t} = \sqrt{\frac{\text{MSSe}}{\text{No. of replication}} \times 100}$$

SEd for treatments = SEm x √2

CD for treatments = SEd x't' value at 5% error degree of freedom.

Where,

SEm ± = Standard Error of treatment means

SEd = Standard Error of difference between two treatments

CD = Critical difference

The results are also presented through bar diagram to show the effect of variables on selected response during storage. The findings of experiments are presented in subsequent chapter.

# RESULT

The present investigation was planned to enhance the shelf life of sugarcane juice using different chemical preservatives (citric acid, potassium metabisulfite, potassium sorbate, ascorbic acid) and pasteurization temperature. The storage study was conducted for 7, 14 and 21 days at refrigerated and ambient condition. The findings of various experiments are presented through table 1to 32 and the results are explained as under:

### 4.1 Chemical Composition of sugarcane juice

The fresh sugarcane cultivar, CO 99004 was procured from JNKVV research farm. The sugarcane was extracted and evaluated for various quality attributes. The findings are presented in Table 1. A perusal of table indicates that juice yield of sugarcane variety was 59 percent. The proximate composition shows that sugarcane juice contain moisture (80%) Protein (.55%) fat (0.19%) crude fibre (13.32%) and ash (0.30%).The cultivar is rich source of sugars. The total soluble sugar TSS of juice was 19 % and 20 Brix. On the basis of quality attributes variety CO99004 grown in Madhya Pradesh was selected for experimental purpose.

### 4.2 Effect of citric acid and pasteurization temperature on chemical composition of stored sugarcane juice

#### 4.2.1 Moisture, Carbohydrate and Total ash content stored sugarcane juice at refrigerated condition.

A cursory view of table 2 reveals the results of effect of citric acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at refrigerated condition. The moisture content in different treatment combinations of stored sugarcane juice for 7,14 and 21 days was found to be 75.4% ($C_2T_1$, $C_3T_1$) to 80.88 ($C_3T_3$); 76.75($C_3T_2$) to 85.6 ($C_3T_3$); 76.4 ($C_2T_1$) to 80.79($C_3T_3$) respectively. Similarly the lowest and highest values of carbohydrate were found to be 13.68% ($C_3T_2$) to 16.20% ($C_2T_1$) for 7 days, 13.73% ($C_1T_3$) to16.27% ($C_2T_3$) for 14 days and 13.82% ($C_3T_1$) to 17.23% ($C_3T_3$) for 7,14 and 21 days of storage period respectively. The highest and lowest values of ash content in stored sugarcane juice were

**Table 1 Chemical Composition of sugarcane juice.**

| S. No | Characteristics | Variety: CO 99004 |
|---|---|---|
| **1.** | Juice yield% | 59 |
| **2.** | Moisture% | 80.00 |
| **3.** | Protein% | 0.55 |
| **4.** | Fat % | 0.19 |
| **5.** | Ash % | 0.30 |
| **6.** | Crude Fibre% | 13.32 |
| **7.** | Total soluble solid | 20.00 |
| **8.** | Total Sugar% | 19.00 |
| **9.** | Acidity % | 0.30 |

**Table 2 Effect of citric acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at refrigerated condition (5° C)**

| Treatments | Storage period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash |
| **$CA_1T_1$** | 75.8 | 14.89 | 0.2 | 80.5 | 14.41 | 0.6 | 76.72 | 16.01 | 0.4 |
| **$CA_2T_1$** | 75.4 | 16.20 | 0.4 | 80.5 | 16.20 | 0.2 | 76.4 | 14.21 | 0.2 |
| **$CA_3T_1$** | 75.4 | 14.78 | 0.4 | 80.12 | 14.84 | 0.3 | 78.58 | 13.82 | 0.2 |
| **$CA_1T_2$** | 76 | 14.36 | 0.2 | 81.43 | 14.78 | 0.4 | 80.12 | 17.16 | 0.4 |
| **$CA_2T_2$** | 79 | 13.97 | 0.4 | 81.43 | 14.84 | 0.4 | 80.4 | 14.01 | 0.4 |
| **$CA_3T_2$** | 76.4 | 13.68 | 0.2 | 76.75 | 15 | 0.3 | 76.72 | 16.46 | 0.6 |
| **$CA_1T_3$** | 76.7 | 14.78 | 0.6 | 80.12 | 13.73 | 0.6 | 80.5 | 13.87 | 0.4 |
| **$CA_2T_3$** | 78.8 | 14.94 | 0.4 | 82.81 | 16.27 | 0.4 | 80.12 | 13.92 | 0.2 |
| **$CA_3T_3$** | 80.88 | 14.67 | 0.2 | 85.6 | 13.78 | 0.2 | 80.79 | 17.23 | 0.4 |
| **CD@5%** | **0.05** | **0.08** | **0.28** | **0.10** | **0.11** | **0.25** | **0.01** | **0.03** | **0.26** |
| **SEM±** | **0.02** | **0.23** | **0.10** | **0.30** | **0.04** | **0.09** | **0.03** | **0.01** | **0.09** |

observed in treatment combinations as follows: $C_1T_3$ (0.6%) & $C_1T_1$, $C_1T_2$, $C_3T_2$, $C_3T_3$ (0.2%) for 7 days; $C_1T_1$, $C_1T_3$ (0.6%) & $C_2T_1$, $C_3T_3$ (0.2%) for 14 days; $C_3T_2$ (0.6%) & $C_2T_1$, $C_3T_1$, $C_2T_3$ (0.2%) for 21 days.

The statistical analysis data indicates that treatments have significant effect on moisture carbohydrate and ash content of stored sugarcane juice. Treatment $CA_3T_3$ was at par to $CA_2T_2$ followed by $CA_2T_3$ as regards for moisture content of juice. Similarly in carbohydrate and ash content treatment $CA_2T_1$ was at par $CA_2T_3$ followed by $CA_1T_1$, CA $_1T_3$ and CA $_2T_1$, followed by $CA_1T_1$ respectively, in 7 days storage of period.

On 14 days of storage period for moisture content treatment $CA_3T_3$ was at par to CA $_2T_3$ followed by $CA_1T_2$. Similarly in carbohydrate and ash content treatment $CA_2T_3$ was at par with $CA_2T_1$ and $CA_3T_1$; treatment $CA_1T_1$ was at par to CA $_1T_2$ followed by $CA_3T_1$ respectively.

Finally on 21 days of storage it was seen that treatment $CA_3T_3$ was at par to $CA_1T_2$ and $CA_1T_3$ for moisture; treatment $CA_3T_3$ was at par to $CA_1T_2$ followed by $CA_3T_2$ for carbohydrate; treatment $CA_3T_2$ was at par with CA $_1T_1$ followed by CA $_2T_1$ for ash content in stored sugarcane juice.

### 4.2.2 Moisture, Carbohydrate and Total ash content stored sugarcane juice at ambient condition.

Table 3 comprises the results of effect of citric acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at ambient condition. The minimum and maximum value of moisture content was seen at treatments $CA_1T_3$ (76.30), & $CA_3T_3$ (81.70); $CA_3T_2$ (76.77) & $CA_3T_3$ (84.35); $CA_1T_1$ (76.10) & $CA_2T_3$ (80.79) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of carbohydrate were found in treatments $CA_3T_2$ (13.73) & $CA_3T_3$ (15.76) for 7 days, $CA_1T_1$ (13.64) & $CA_2T_2$ (17.16) for 14 days and $CA_2$T1 (17.23) & CA1T3 (18.16) for 21 days. Finally, for ash content the higher and lower values were as follows: $CA_2T_{1,}$ $CA_2T_2$ and $CA_3T_2$ (0.4) & $CA_3T_1$, $CA_1T_2$, $CA_3T_2$,(0.2) for 7 days; $CA_1T_{1,}$ $CA_2T_1$**,** $CA_2T_{2,}$ $CA_3T_2$ $CA_1T_3$ & $CA_2T_3$ (0.4) & $CA_3T_{1,}$ $CA_1T_2$ $CA_3T_3$ (0.2) for 14 days; $CA_1T_3$, $CA_2T_3$, (0.4) & $CA_1T_1$, $CA_2T_1$, $CA_1T_2$, $CA_2T_2$, $CA_3T_2$,$CA_3T_3$ (0.2) for 21 days.

**Table 3 Effect of citric acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at ambient condition (30° C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash |
| $CA_1T_1$ | 76.91 | 13.97 | 0.3 | 80.80 | 13.64 | 0.4 | 76.10 | 17.23 | 0.2 |
| $CA_2T_1$ | 76.80 | 14.16 | 0.4 | 80.54 | 13.78 | 0.4 | 76.50 | 13.78 | 0.2 |
| $CA_3T_1$ | 76.62 | 13.78 | 0.2 | 81.80 | 14.01 | 0.2 | 80.50 | 15.76 | 0.3 |
| $CA_1T_2$ | 77.20 | 13.92 | 0.2 | 80.87 | 13.68 | 0.2 | 80.61 | 14.26 | 0.2 |
| $CA_2T_2$ | 77.70 | 14.52 | 0.4 | 81.57 | 17.16 | 0.4 | 80.50 | 17.84 | 0.2 |
| $CA_3T_2$ | 76.50 | 13.73 | 0.4 | 76.77 | 14.11 | 0.4 | 80.50 | 13.78 | 0.2 |
| $CA_1T_3$ | 76.30 | 14.31 | 0.3 | 81.12 | 14.41 | 0.4 | 80.40 | 18.16 | 0.4 |
| $CA_2T_3$ | 78.41 | 13.82 | 0.3 | 82.54 | 14.16 | 0.4 | 81.40 | 14.01 | 0.4 |
| $CA_3T_3$ | 81.70 | 15.76 | 0.2 | 84.35 | 16.40 | 0.2 | 80.50 | 16.40 | 0.2 |
| **CD@5%** | **2.80** | **2.56** | **0.05** | **2.660** | **2.41** | **0.05** | **2.36** | **2.23** | **0.04** |
| **SEM±** | **0.96** | **0.88** | **0.02** | **0.92** | **0.83** | **0.02** | **0.81** | **0.77** | **0.01** |

The table 3 indicates that treatment $CA_3T_3$ was at par to $CA_2T_3$ followed by $CA_2T_2$ in moisture, similarly in carbohydrate and Ash content treatment $CA_3T_3$ was at par $CA_2T_2$ followed by $CA_1T_3$; $CA_2T_1$ was at par with $CA_1T_1$, followed by $CA_3T_1$ respectively, in 7 days of storage period.

On 14 days of storage period for moisture treatment $CA_3T_3$ was at par to $CA_2T_3$ followed by $CA_3T_1$; in carbohydrate treatment $CAT_2$ was at par with $CA_3T_3$ and $CA_1T_3$; treatment $CA_1T_1$ was at par to $CA_2T_1$ followed by $CA_3T_1$ in ash content.

Finally on 21 days of storage it was seen that treatment $CA_2T_3$ was at par to $CA_1T_2$ and $CA_3T_1$ for moisture; for carbohydrate $CA_1T_3$ was at par to $CA_2T_2$ followed by $CA_1T_1$; in ash treatment $CA_1T_3$ was at par with $CA_3T_1$ followed by $CA_1T_1$.

### 4.2.3 Total sugar, Reducing sugar and Titrable acidity of stored sugarcane juice at refrigerated condition.

A perusal of table 4 shows the effect of citric acid and pasteurization temperature was seen on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition. The minimum and maximum value of total sugar content was seen in treatments 19.91 ($CA_1T_{2,}$ $CA_3T_2$), & 16.78 ($CA_1T_{3,}$ $CA_3T_3$); 19.86 ($CA_1T_{2,}$ $CA_3T_2$) & 16.71 ($CA_3T_3$); 19.81 ($CA_1T_{2,}$ $CA_3T_2$) & 16.65 ($CA_3T_3$) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of reducing sugar were found in treatments $CA_2T_2$ (0.242) & $CA_1T_2$ (0.204) for 7 days, $CA_3T_1$ (0.364) & $CA_1T_2$ (0.258) for 14 days and $CA_2T_1$ (0.679) & $CA_3T_1$ (0.399) for 21 days. The higher and lower values of titrable acidity were found in treatments to be $CA_1T_1$ (0.26) & $CA_2T_2$ (0.53) and for 7 days; $CA_1T_1$,(0.35) & $CA_2T_{2,}$ (0.62) for 14 days; $CA_2T_2$ $CA_2T_3$ (0.70) & $CA_1T_1$ (0.42) for 21 days.

The findings also indicates that treatment $CA_1T_2$ was at par to $CA_2T_2$ followed by $CA_2T_3$ in total sugar, similarly in case of reducing sugar and titrable acidity, treatment $CA_2T_2$ was at par $CA_2T_3$ followed by $CA_3T_2$; $CA_2T_1$ was at par with $CA_1T_1$, followed by $CA_3T_1$ respectively, in 7 days storage of period.

**Table 4 Effect of citric acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition (5° C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity |
| **$CA_1T_1$** | 18.11 | 0.240 | 0.26 | 18.06 | 0.334 | 0.35 | 18.01 | 0.626 | 0.42 |
| **$CA_2T_1$** | 18.11 | 0.220 | 0.46 | 18.04 | 0.279 | 0.55 | 18.00 | 0.679 | 0.63 |
| **$CA_3T_1$** | 17.53 | 0.215 | 0.47 | 17.47 | 0.364 | 0.56 | 17.42 | 0.399 | 0.63 |
| **$CA_1T_2$** | 19.91 | 0.204 | 0.44 | 19.86 | 0.258 | 0.53 | 19.81 | 0.543 | 0.61 |
| **$CA_2T_2$** | 19.49 | 0.264 | 0.53 | 19.43 | 0.318 | 0.62 | 19.38 | 0.599 | 0.70 |
| **$CA_3T_2$** | 19.91 | 0.242 | 0.49 | 19.86 | 0.351 | 0.58 | 19.81 | 0.443 | 0.66 |
| **$CA_1T_3$** | 16.78 | 0.211 | 0.37 | 16.72 | 0.283 | 0.46 | 16.67 | 0.509 | 0.61 |
| **$CA_2T_3$** | 18.17 | 0.247 | 0.49 | 18.11 | 0.291 | 0.58 | 18.05 | 0.485 | 0.70 |
| **$CA_3T_3$** | 16.78 | 0.227 | 0.40 | 16.71 | 0.275 | 0.49 | 16.65 | 0.438 | 0.66 |
| **CD@5%** | **2.46** | **0.16** | **21.15** | **2.20** | **0.24** | **0.23** | **2.33** | **0.25** | **0.34** |
| **SEM±** | **0.85** | **0.06** | **7.27** | **0.76** | **0.08** | **0.08** | **0.80** | **0.09** | **0.12** |

On 14 days of storage period as regards for total sugar, treatment combination $CA_2T_2$ was at par to $CA_3T_2$ followed by $CA_3T_1$; treatment $CA_3T_1$ was at par with $CA_3T_2$ and $CA_1T_1$; treatment $CA_2T_2$ was at par to $CA_3T_2$ followed by $CA_3T_1$ in titrable acidity.

On 21 days of storage period it was seen that treatment $CA_1T_2$ was at par to $CA_2T_2$ and $CA_2T_3$ for total sugar); $CA_2T_1$ was at par to $CA_1T_1$ followed by $CA_1T_2$ for reducing sugar; $CA_2T_2$ was at par with $CA_3T_2$ followed by $CA_2T_1$ for titrable acidity respectively.

### 4.2.4 Total sugar, Reducing sugar and Titrable acidity of stored sugarcane juice at ambient condition.

Table 5 comprises the results of effect of citric acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition. The minimum and maximum value of total sugar content was seen at treatments $CA_2T_1$ (22.62) & $CA_1T_1$ (17.86); $CA_1T_1$ (22.56) & $CA_1T_1$ (17.81); $CA_2T_1$ (22.52) & $CA_1T_1$ (17.77) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of reducing sugar were found in treatments $CA_1T_1$ (0.271) & $CA_2T_2$ (0.204) for 7 days, $CA_2T_2$ (0.370) & $CA_1T_3$ (0.273) for 14 days and $CA_1T_3$ (0.679) & $CA_2T_3$ (0.424) for 21 days storage period. The higher and lower values titrable acidity were as follows: $CA_3T_3$ (0.53) & $CA_1T_1$ (0.28) and for 7 days; $CA_3T_3$, (0.62) & $CA_1T_{1,}$ (0.37) for 14 days; $CA_3T_3$ (0.70) & $CA_1T_1$ (0.45) for 21 days.

The statistical analysis of reveals that treatment $CA_2T_1$ was at par to $CA_3T_1$ followed by $CA_3T_3$ in case of total sugar, similarly in reducing sugar and titrable acidity treatment $CA_1T_1$ was at par $CA_3T_1$ followed by $CA_3T_3$; $CA_3T_3$ was at par with $CA_1T_3$, followed by $CA_1T_2$ respectively, in 7 days storage of period.

On 14 days of storage period for total sugar, treatment $CA_2T_1$ was at par to $CA_3T_1$ followed by $CA_3T_3$; in case of reducing sugar $CA_2T_2$ was at par with $CA_3T_2$ and $CA_1T_1$and treatment $CA_3T_3$ was at par to $CA_1T_3$ followed by $CA_1T_2$ in titrable acidity.

On 21 days of storage period, it was seen that treatment $CA_2T_1$ was at par to $CA_1T_3$ and $CA_3T_1$ for total sugar; for reducing sugar $CA_2T_1$ was at par to

**Table 5 Effect of citric acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition (30° C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity |
| **$CA_1T_1$** | 17.86 | 0.271 | 0.28 | 17.81 | 0.318 | 0.37 | 17.77 | 0.590 | 0.45 |
| **$CA_2T_1$** | 22.62 | 0.219 | 0.45 | 22.56 | 0.287 | 0.54 | 22.52 | 0.657 | 0.62 |
| **$CA_3T_1$** | 20.49 | 0.264 | 0.43 | 20.44 | 0.313 | 0.52 | 20.39 | 0.574 | 0.60 |
| **$CA_1T_2$** | 18.75 | 0.242 | 0.50 | 18.69 | 0.302 | 0.59 | 18.63 | 0.485 | 0.67 |
| **$CA_2T_2$** | 18.75 | 0.204 | 0.49 | 18.7 | 0.370 | 0.58 | 18.65 | 0.515 | 0.66 |
| **$CA_3T_2$** | 18.11 | 0.211 | 0.39 | 18.05 | 0.351 | 0.48 | 18 | 0.668 | 0.54 |
| **$CA_1T_3$** | 20.49 | 0.235 | 0.51 | 20.44 | 0.273 | 0.60 | 20.4 | 0.679 | 0.68 |
| **$CA_2T_3$** | 19.84 | 0.226 | 0.42 | 19.79 | 0.291 | 0.51 | 19.73 | 0.424 | 0.59 |
| **$CA_3T_3$** | 20.24 | 0.255 | 0.53 | 20.2 | 0.299 | 0.62 | 20.16 | 0.468 | 0.70 |
| **CD@5%** | **2.13** | **0.10** | **0.27** | **2.51** | **0.20** | **24.61** | **1.87** | **0.23** | **0.21** |
| **SEM±** | **0.73** | **0.04** | **0.09** | **0.86** | **0.07** | **8.46** | **0.64** | **0.08** | **0.07** |

$CA_1T_1$ followed by $CA_1T_2$ and in titrable acidity treatment $CA_2T_2$ was at par with $CA_3T_2$ followed by $CA_2T_1$.

### 4.2.5 Poly phenol oxidease, Total soluble solid and Phenol content stored sugarcane juice at refrigerated condition

Table 6 presents the results of effect of citric acid and pasteurization temperature on poly phenol oxidease, total soluble solid and phenol content of stored sugarcane juice at refrigerated condition. The minimum and maximum value of poly phenol oxidease activity was seen in treatments $CA_1T_1$, $CA_1T_2$ (0.035) & $CA_3T_3$ (0.027); $CA_2T_{1,}$ $CA_1T_{2,}$ $CA_2T_2$ (0.023) & $CA_2T_3$ (0.018); $CA_1T_1$ (0.024) & $CA_2T_3$ (0.015) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of total soluble solid were found in treatments $CA_3T_3$ (20.5) & $CA_1T_1$ (19.1) for 7 days, $CA_2T_3$ (19.8) & $CA_1T_1$ (18.8) for 14 days and $CA_2T_3$ (19.6) & $CA_1T_1$ (18.5) for 21 days. The higher and lower values phenol content were found to be: $CA_1T_2$ (14.76) & $CA_2T_1$ (14.55) and for 7 days; $CA_1T_2$, (15.16) & $CA_2T_{1,}$ (14.95) for 14 days and $CA_1T_2$ (15.56) & $CA_1T_1$ (15.4) for 21 days.

The statistical analysis shows that treatment $CA_1T_1$ was at par to $CA_2T_1$ followed by $CA_3T_1$ in case of poly phenol oxidease activity, similarly in case of total soluble solid and phenol content treatment, $CA_3T_3$ was at par $CA_2T_3$ followed by $CA_3T_1$and $CA_1T_2$ was at par with $CA_3T_1$, followed by $CA_2T_2$ respectively, in 7 days storage of period.

On 14 days of storage period for poly phenol oxidease activity treatment, $CA_1T_1$ was at par to $CA_2T_1$ followed by $CA_3T_1$; in $CA_2T_3$ was at par with $CA_3T_1$ and $CA_3T_2$ and treatment $CA_1T_2$ was at par to $CA_2T_3$ followed by $CA_1T_3$ in phenol content.

Finally on 21 days of storage it was seen that treatment $CA_1T_1$ was at par to $CA_2T_1$ and $CA_3T_1$ for poly phenol oxidease activity; for total soluble solid $CA_2T_3$ was at par to $CA_3T_1$ followed by $CA_3T_2$ and in phenol content treatment $CA_1T_2$ was at par with $CA_1T_3$ followed by $CA_3T_1$.

**Table 6 Effect of citric acid and pasteurization temperature on poly phenol oxidase (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice at refrigerated condition (5° C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | PPO | TSS | Phenol | PPO | TSS | Phenol | PPO | TSS | Phenol |
| **$CA_1T_1$** | 0.035 | 19.1 | 14.60 | 0.025 | 18.8 | 15 | 0.024 | 18.5 | 15.4 |
| **$CA_2T_1$** | 0.034 | 19.5 | 14.55 | 0.023 | 19.2 | 14.95 | 0.022 | 18.9 | 15.35 |
| **$CA_3T_1$** | 0.033 | 19.8 | 14.65 | 0.022 | 19.5 | 15.05 | 0.021 | 19.2 | 15.45 |
| **$CA_1T_2$** | 0.035 | 19.7 | 14.76 | 0.023 | 19.5 | 15.16 | 0.022 | 19.2 | 15.56 |
| **$CA_2T_2$** | 0.031 | 19.5 | 14.63 | 0.023 | 19.2 | 15.03 | 0.021 | 18.8 | 15.43 |
| **$CA_3T_2$** | 0.030 | 19.5 | 14.67 | 0.022 | 19.3 | 15.07 | 0.020 | 19 | 15.47 |
| **$CA_1T_3$** | 0.034 | 19.8 | 14.74 | 0.019 | 19.5 | 15.08 | 0.017 | 19.3 | 15.54 |
| **$CA_2T_3$** | 0.030 | 20.2 | 14.63 | 0.018 | 19.8 | 15.14 | 0.015 | 19.6 | 15.43 |
| **$CA_3T_3$** | 0.027 | 20.5 | 14.65 | 0.019 | 19.2 | 15.03 | 0.017 | 18.9 | 15.45 |
| **CD@5%** | **0.02** | **2.51** | **2.35** | **0.04** | **2.42** | **2.23** | **0.05** | **1.84** | **2.15** |
| **SEM±** | **0.01** | **0.86** | **0.81** | **0.01** | **0.83** | **0.77** | **0.02** | **0.63** | **0.74** |

### 4.2.6 Poly phenol oxidease, Total soluble solid and Phenol content stored sugarcane juice at ambient condition

The results of effect of citric acid and pasteurization temperature on poly phenol oxidease activity, total soluble solid and phenol content of stored sugarcane juice at ambient condition are presented in table 7. The minimum and maximum value of poly phenol oxidease activity was seen in treatments $CA_1T_1$, $CA_1T_2$ (0.055) & $CA_3T_3$ (0.047); $CA_1T_1$ (0.045), & $CA_3T_3$ (0.031); $CA_1T_1$ (0.039) & $CA_3T_3$ (0.026) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of total soluble solid were found in treatments $CA_2T_3$ (19.8) & $CA_1T_1$ (18.8) for 7 days, $CA_2T_3$ (19.6) & $CA_1T_1$ (18.6) for 14 days and $CA_1T_2$, $CA_2T_3$ (19.3) & $CA_1T_1$ (18.3) for 21 days. The highest and lowest content of phenol were found in treatment combination to be: $CA_1T_2$ (14.36) & $CA_2T_1$ (14.15) and for 7 days; $CA_1T_2$, (14.76) & $CA_2T_1$, (14.55) for 14 days; $CA_1T_2$ (15.16) & $CA_2T_1$ (14.95) for 21 day.

The treatment $CA_1T_1$ was at par to $CA_2T_1$ followed by $CA_3T_1$ in Poly phenol oxidease, similarly in total soluble solid and phenol content treatment $CA_3T_3$ was at par $CA_2T_3$ followed by $CA_3T_1$; $CA_1T_2$ was at par with $CA_3T_1$, followed by $CA_2T_2$ respectively, in 7 days storage of period (Table 7).

On 14 days of storage period for poly phenol oxidease activity treatment $CA_1T_1$ was at par to $CA_2T_1$ followed by $CA_3T_1$; in $CA_2T_3$ was at par with $CA_3T_1$ and $CA_3T_2$ and treatment $CA_1T_2$ was at par to $CA_2T_3$ followed by $CA_1T_3$ in phenol content.

Finally on 21 days of storage period, it was seen that treatment $CA_1T_1$ was at par to $CA_2T_1$ and $CA_3T_1$ for poly phenol oxidease activity; for total soluble solid $CA_2T_3$ was at par to $CA_3T_1$ followed by $CA_3T_2$; in phenol content treatment $CA_1T_2$ was at par with $CA_1T_3$ followed by $CA_3T_1$.

**Table 7 Effect of citric acid and pasteurization temperature on poly phenol oxidase (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice at ambient condition (30°C)**

| Treatment | Storage period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | PPO | TSS | Phenol | PPO | TSS | Phenol | PPO | TSS | Phenol |
| $CA_1T_1$ | 0.055 | 18.8 | 14.20 | 0.045 | 18.6 | 14.60 | 0.039 | 18.3 | 15 |
| $CA_2T_1$ | 0.054 | 19.2 | 14.15 | 0.043 | 19 | 14.55 | 0.034 | 18.7 | 14.95 |
| $CA_3T_1$ | 0.053 | 19.5 | 14.25 | 0.042 | 19.3 | 14.65 | 0.034 | 19 | 15.05 |
| $CA_1T_2$ | 0.055 | 19.7 | 14.36 | 0.043 | 19.5 | 14.76 | 0.031 | 19.3 | 15.16 |
| $CA_2T_2$ | 0.051 | 19.5 | 14.23 | 0.043 | 19.2 | 14.63 | 0.030 | 18.9 | 15.03 |
| $CA_3T_2$ | 0.05 | 19.5 | 14.27 | 0.042 | 19.3 | 14.67 | 0.028 | 19 | 15.07 |
| $CA_1T_3$ | 0.054 | 19.5 | 14.34 | 0.038 | 19.2 | 14.74 | 0.029 | 18.8 | 15.14 |
| $CA_2T_3$ | 0.05 | 19.8 | 14.23 | 0.035 | 19.6 | 14.63 | 0.029 | 19.3 | 15.03 |
| $CA_3T_3$ | 0.047 | 19.2 | 14.25 | 0.031 | 19 | 14.65 | 0.026 | 18.6 | 15.05 |
| **CD@5%** | **0.03** | **1.05** | **0.44** | **0.02** | **1.05** | **0.52** | **0.02** | **1.07** | **0.41** |
| **SEM±** | **0.01** | **0.36** | **0.15** | **0.01** | **0.36** | **0.18** | **0.01** | **0.37** | **0.14** |

## 4.3 Effect of Potassium metabisulfite and pasteurization temperature on chemical composition of stored sugarcane juice

### 4.3.1 Moisture, Carbohydrate and Total ash content: of stored sugarcane juice at refrigerated condition

The effect of potassium meta bisulphite and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at refrigerated condition is presented in table 8. The maximum and minimum value of moisture content was seen at treatments $KMS_3T_3$ (81.43) & $KMS_1T_1$ (75.2); $KMS_3T_3$ (85.4), & $KMS_3T_2$ (77.5); $KMS_2T_3$ (82.2) & $KMS_1T_1$ (76.4) for 7, 14 and 21 days storage respectively. Similarly the highest and lowest values of carbohydrate were found in treatments $KMS_1T_2$ (16.74) & $KMS_2T_2$ (13.73) for 7 days, $KMS_3T_3$ (17.02) & $KMS_3T_2$ (13.59) for 14 days and $KMS_3T_1$, (16.40) & $KMS_3T_2$ (13.92) for 21 days. The total ash content were higher and lower in the following treatment combinations: $KMS_2T_1$, $KMS_1T_2$ $KMS_3T_2$ $KMS_1T_3$ & $KMS_3T_3$ (0.4) and $KMS_1T_1$, $KMS_2T_3$ (0.2) for 7 days; $KMS_1T_2$, (0.6) & $KMS_3T_1$, $KMS_3T_3$ (0.2) for 14 days; $KMS_1T_1$, $KMS_3T_1$, $KMS_1T_2$, $KMS_2T_2$, $KMS_1T_3$ & $KMS_2T_3$ (0.4) & $KMS_2T_1$ $KMS_3T_3$ (0.2) for 21 day.

The statistical analysis data indicates that treatments have got significant effect on moisture carbohydrate and ash content of stored sugarcane juice. Treatment $KMS_3T_3$ was at par to $KMS_2T_3$ followed by $KMS_2T_3$ as regards for moisture content of juice. Similarly in carbohydrate and ash content treatment $KMS_1T_2$ was at par $KMS_3T_3$ followed by $KMS_2T_1$, $KMS_2T_1$ and $KMS_1T_2$, followed by $KMS_1T_1$ respectively, in 7 days storage of period.

On 14 days of storage period for moisture content treatment $KMS_3T_3$ was at par to $KMS_2T_3$ followed by $KMS_2T_2$. Similarly in carbohydrate and total ash content treatment $KMS_3T_3$ was at par with $KMS_2T_3$ and $KMS_1T_2$; treatment $KMS_1T_2$ was at par to $KMS_1T_1$ followed by $KMS_2T_1$ respectively.

On 21 days of storage it was seen that treatment combination $KMS_2T_3$ was at par to $KMS_2T_2$ and $KMS_3T_2$ for moisture; treatment combination $KMS_3T_1$ was at par to $KMS_1T_3$ followed by $KMS_1T_2$ for carbohydrate and

**Table 8 Effect of Potassium metabisulfite and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at refrigerated condition (5°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash |
| **$KMS_1T_1$** | 75.2 | 14.06 | 0.2 | 81.43 | 14.26 | 0.4 | 76.4 | 14.36 | 0.4 |
| **$KMS_2T_1$** | 75.82 | 14.46 | 0.4 | 78.58 | 14.36 | 0.3 | 76.47 | 14.46 | 0.2 |
| **$KMS_3T_1$** | 75.61 | 14.21 | 0.3 | 80.2 | 14.41 | 0.2 | 79 | 16.40 | 0.3 |
| **$KMS_1T_2$** | 76.7 | 16.74 | 0.4 | 80.5 | 16.27 | 0.6 | 80.01 | 15.06 | 0.4 |
| **$KMS_2T_2$** | 78.52 | 13.73 | 0.3 | 81.66 | 13.97 | 0.4 | 80.79 | 15.00 | 0.4 |
| **$KMS_3T_2$** | 76.2 | 13.97 | 0.4 | 77.5 | 13.59 | 0.3 | 80.12 | 13.92 | 0.3 |
| **$KMS_1T_3$** | 76.54 | 13.97 | 0.4 | 80.79 | 15.06 | 0.4 | 80.15 | 16.01 | 0.4 |
| **$KMS_2T_3$** | 78.4 | 14.31 | 0.2 | 82.7 | 16.88 | 0.4 | 82.2 | 14.21 | 0.4 |
| **$KMS_3T_3$** | 81.43 | 15.58 | 0.4 | 85.4 | 17.02 | 0.2 | 80.12 | 14.41 | 0.2 |
| **CD@5%** | **2.83** | **2.10** | **0.20** | **2.63** | **2.28** | **0.06** | **0.06** | **0.09** | **0.04** |
| **SEM±** | **0.97** | **0.72** | **0.07** | **0.91** | **0.78** | **0.02** | **0.02** | **0.03** | **0.01** |

treatment combination $KMS_1T_1$ was at par with $KMS_3T_2$ followed by $KMS_2T_1$ for ash content in stored sugarcane juice.

### 4.3.2 Moisture, Carbohydrate and Total ash content: of stored sugarcane juice at ambient condition

The effect of potassium meta bisulphite and pasteurization temperature treatment combination on moisture, carbohydrate and ash content of stored sugarcane juice at ambient condition is presented in table 9. The maximum and minimum value of moisture content was seen in treatments $KMS_3T_3$ (81.74) & $KMS_1T_2$ (76.32); $KMS_3T_3$ (85.10) & $KMS_3T_2$ (77.40); $KMS_2T_3$ (81.75) & $KMS_1T_1$ (76.50) for 7, 14 and 21 days respectively. Similarly the highest and lowest values of carbohydrate were found in treatments $KMS_1T_2$ (17.23) & $KMS_2T_{1,}$ $KMS_2T_{2,}$ $KMS_2T_3$ (13.78) for 7 days, $KMS_2T_1$ (16.60) & $KMS_1T_{1,}$ $KMS_2T_{3,}$ (13.78) for 14 days and $KMS_3T_{2,}$ (18.33) & $KMS_1T_1$ (13.73) for 21 days. Finally, for ash content the higher and lower values were as follows: $KMS_1T_2$, $KMS_2T_{2,}$ $KMS_1T_3$ (0.4) and $KMS_2T_{1,}$ $KMS_3T_{1,}$ $KMS_3T_2$ and $KMS_3T_3$ (0.2) for 7 days; $KMS_2T_2$, $KMS_3T_{2,}$ $KMS_1T_3$ (0.4) & $KMS_1T_{1,}$ $KMS_3T_{1,}$ $KMS_1T_2$ (0.2) for 14 days; $KMS_3T_{2,}$ (0.6) & $KMS_2T_{1,}$ $KMS_3T_{1,}$ $KMS_2T_{2,}$ $KMS_1T_{3,}$ $KMS_3T_3$ (0.2) for 21 day.

The statistical analysis data indicates that significant difference exist among the treatment combination for moisture, carbohydrate and ash content of stored sugarcane juice. Treatment combination $KMS_3T_3$ was at par to $KMS_2T_3$ followed by $KMS_2T_2$ as regards for moisture content of juice. Similarly in carbohydrate and ash content treatment $KMS_1T_2$ was at par $KMS_1T_3$ followed by $KMS_1T_1$, $KMS_1T_2$ and $KMS_2T_2$ followed by $KMS_1T_1$ respectively, in 7 days storage of period.

On 14 days of storage period treatment combination $KMS_3T_3$ was at par to $KMS_2T_3$ followed by $KMS_1T_3$ for moisture content. Similarly in carbohydrate and ash content of juice treatment combination $KMS_2T_1$ was at par with $KMS_1T_3$ and $KMS_2T_2$; treatment combination $KMS_2T_2$ was at par to $KMS_2T_1$ followed by $KMS_1T_1$ respectively.

Upon 21 days of storage it was seen that treatment combination $KMS_2T_3$ was at par to $KMS_1T_3$ and $KMS_3T_2$ for moisture; treatment $KMS_3T_2$

**Table 9 Effect of Potassium metabisulfite and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at refrigerated condition (30 °C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash |
| **KMS $_1$T$_1$** | 76.87 | 14.57 | 0.3 | 80.40 | 13.78 | 0.2 | 76.50 | 13.73 | 0.4 |
| **KMS $_2$T$_1$** | 76.54 | 13.78 | 0.2 | 81.20 | 16.60 | 0.3 | 77.11 | 17.61 | 0.2 |
| **KMS $_3$T$_1$** | 76.50 | 14.16 | 0.2 | 81.24 | 13.97 | 0.2 | 80.37 | 14.16 | 0.2 |
| **KMS $_1$T$_2$** | 76.32 | 17.23 | 0.4 | 81.21 | 14.16 | 0.2 | 80.50 | 16.33 | 0.4 |
| **KMS $_2$T$_2$** | 77.81 | 13.78 | 0.4 | 82.00 | 14.26 | 0.4 | 80.10 | 14.31 | 0.2 |
| **KMS $_3$T$_2$** | 76.48 | 14.52 | 0.2 | 77.40 | 14.11 | 0.4 | 81.21 | 18.33 | 0.6 |
| **KMS $_1$T$_3$** | 76.54 | 16.67 | 0.4 | 81.41 | 14.67 | 0.4 | 81.40 | 14.11 | 0.2 |
| **KMS $_2$T$_3$** | 78.90 | 13.78 | 0.3 | 82.61 | 13.78 | 0.3 | 81.75 | 14.67 | 0.4 |
| **KMS $_3$T$_3$** | 81.74 | 14.06 | 0.2 | 85.10 | 13.92 | 0.3 | 81.21 | 14.52 | 0.2 |
| **CD@5%** | **1.87** | **1.08** | **0.04** | **1.87** | **1.87** | **0.04** | **2.63** | **2.61** | **0.05** |
| **SEM±** | **0.64** | **0.37** | **0.01** | **0.64** | **0.64** | **0.01** | **0.91** | **0.09** | **0.02** |

was at par to $KMS_2T_1$ followed by $KMS_1T_2$ for carbohydrate and for ash content in stored sugarcane juice treatment $KMS_3T_2$ was at par with $KMS_1T_1$, $KMS_1T_2$ followed by $KMS_2T_1$.

### 4.3.3 Total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition:

Table 10, comprises the results of effect of potassium meta bisulphite and pasteurization temperature treatment combination on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition. The minimum and maximum value of total sugar content for 7, 14 and 21 days were found for treatments $KMS_1T_3$ (16.78) & $KMS_2T_1$ (22.62); $KMS_1T_3$ (16.73) & $KMS_2T_1$ (22.56); $KMS_1T_3$ (16.69) & $KMS_2T_1$ (22.5) respectively. Similarly the lowest and highest values of reducing sugar were found in treatments $KMS_2T_3$ (0.209) & $KMS_1T_2$ (0.258) for 7 days, $KMS_3T_1$ (0.266) & $KMS_3T_2$ (0.370) for 14 days and $KMS_1T_1$ (0.374) & $KMS_2T_2$ (0.657) for 21 days storage period. The higher and lower values of titrable acidity were as follows: $KMS_1T_3$ (0.51) & $KMS_1T_1$ (0.27) for 7 days; $KMS_1T_3$, $KMS_3T_3$ (0.60) & $KMS_1T_1$ (0.36) for 14 days; $KMS_1T_3$ (0.68) & $KMS_1T_2$ (0.43) for 21 days.

The statistical analysis data indicates that significant difference exist among the treatment combination. The treatment $KMS_2T_1$ was at par to $KMS_1T_1$, $KMS_3T_2$ followed by $KMS_2T_2$ in case of total sugar, similarly in reducing sugar and titrable acidity, treatment $KMS_1T_2$ was at par to $KMS_2T_2$ followed by $KMS_2T_1$; $KMS_1T_3$, $KMS_3T_3$ collectively were at par with $KMS_2T_2$, followed by $KMS_1T_2$ respectively, in 7 days storage of period.

On 14 days of storage period for total sugar, treatment $KMS_2T_1$ was at par to $KMS_3T_2$ followed by $KMS_1T_1$; in case of reducing sugar $KMS_3T_2$ was at par with $KMS_2T_2$ followed by $KMS_1T_2$ and the treatments $KMS_1T_3$ and $KMS_3T_3$ were collectively at par to $KMS_2T_2$ followed by $KMS_1T_2$ in case of titrable acidity.

On 21 days of storage period, it was found that treatment $KMS_2T_1$ was at par to $KMS_3T_2$ and $KMS_1T_1$ for total sugar; for reducing sugar $KMS_2T_2$ was

**Table 10 Effect of Potassium metabisulfite and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition (5° C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity |
| **$KMS_1T_1$** | 20.24 | 0.227 | 0.27 | 20.17 | 0.295 | 0.36 | 20.12 | 0.374 | 0.43 |
| **$KMS_2T_1$** | 22.62 | 0.234 | 0.46 | 22.56 | 0.277 | 0.55 | 22.5 | 0.392 | 0.63 |
| **$KMS_3T_1$** | 18.52 | 0.226 | 0.41 | 18.45 | 0.266 | 0.50 | 18.4 | 0.608 | 0.59 |
| **$KMS_1T_2$** | 18.11 | 0.258 | 0.48 | 18.05 | 0.339 | 0.57 | 18 | 0.626 | 0.65 |
| **$KMS_2T_2$** | 18.92 | 0.248 | 0.50 | 18.86 | 0.345 | 0.59 | 18.81 | 0.657 | 0.67 |
| **$KMS_3T_2$** | 20.24 | 0.214 | 0.40 | 20.38 | 0.370 | 0.49 | 20.33 | 0.468 | 0.57 |
| **$KMS_1T_3$** | 16.78 | 0.210 | 0.51 | 16.73 | 0.299 | 0.60 | 16.69 | 0.522 | 0.68 |
| **$KMS_2T_3$** | 18.17 | 0.209 | 0.41 | 18.11 | 0.297 | 0.50 | 18.05 | 0.509 | 0.59 |
| **$KMS_3T_3$** | 18.85 | 0.233 | 0.51 | 18.78 | 0.316 | 0.60 | 18.74 | 0.566 | 0.67 |
| **CD@5%** | **2.26** | **0.05** | **0.32** | **1.78** | **0.24** | **0.43** | **2.53** | **0.05** | **0.47** |
| **SEM±** | **0.78** | **0.02** | **0.11** | **0.61** | **0.08** | **0.15** | **0.87** | **0.02** | **0.16** |

at par to $KMS_1T_2$ followed by $KMS_3T_1$ and in case of titrable acidity the treatment $KMS_1T_3$ was at par with $KMS_3T_3$, $KMS_2T_2$ followed by $KMS_1T_2$.

### 4.3.4 Total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition:

Table 11 indicates the effect of potassium meta bisuphite and pasteurization temperature on total sugar, reducing sugar, titrable acidity of stored sugarcane juice at ambient condition. The minimum and maximum range of total sugar content was seen in treatments $KMS_3T_1$ (15.05) & $KMS_2T_1$ (23.61); $KMS_3T_1$ (15.00) & $KMS_2T_1$ (23.56); $KMS_3T_1$ (14.94) & $KMS_2T_1$ (23.51) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of reducing sugar were found in treatments $KMS_3T_2$ (0.212) & $KMS_2T_2$ (0.281) for 7 days, $KMS_1T_2$ (0.271) & $KMS_1T_3$ (0.370) for 14 days and $KMS_3T_2$ (0.407) & $KMS_1T_3$ (0.679) for 21 days. In case of titrable acidity content the minimum and maximum values were as follows: $KMS_3T_1$ (0.28) & $KMS_2T_2$ (0.53) for 7 days; $KMS_3T_1$ (0.37) & $KMS_2T_2$ (0.62) for 14 days; $KMS_3T_1$ (0.45) & $KMS_2T_2$ (0.70) for 21 days.

The statistical analysis of data indicates that treatments have got significant effect on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition. The treatment combination $KMS_2T_1$ was at par to $KMS_2T_2$ followed by $KMS_1T_1$ for total sugar, similarly in case of reducing sugar and titrable acidity, treatment $KMS_2T_2$ was at par with $KMS_3T_1$ followed by $KMS_3T_3$, and $KMS_2T_2$ was at par with $KMS_3T_3$, followed by $KMS_2T_1$ respectively, on 7 days storage of period.

On 14 days of storage period for total sugar, treatment $KMS_2T_1$ was at par to $KMS_2T_2$ followed by $KMS_1T_1$; in reducing sugar the treatment $KMS_1T_3$ was at par with $KMS_2T_1$ and $KMS_3T_2$; treatment $KMS_2T_2$ was at par to $KMS_3T_3$ followed by $KMS_2T_1$ in titrable acidity.

Upon 21 days of storage, it was seen that treatment combination $KMS_2T_1$ was at par to $KMS_2T_2$ and $KMS_1T_1$ for total sugar; for reducing sugar treatment $KMS_1T_3$ was at par to $KMS_2T_3$ followed by $KMS_1T_2$ and in case of titrable acidity, treatment $KMS_2T_2$ was at par with $KMS_3T_3$ followed by $KMS_2T_3$.

**Table 11 Effect of Potassium metabisulfate and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition (30° C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity |
| **$KMS_1T_1$** | 19.49 | 0.248 | 0.37 | 19.43 | 0.291 | 0.46 | 19.38 | 0.558 | 0.54 |
| **$KMS_2T_1$** | 23.61 | 0.221 | 0.50 | 23.56 | 0.345 | 0.59 | 23.51 | 0.599 | 0.56 |
| **$KMS_3T_1$** | 15.05 | 0.255 | 0.28 | 15 | 0.283 | 0.37 | 14.94 | 0.452 | 0.45 |
| **$KMS_1T_2$** | 16.37 | 0.237 | 0.44 | 16.32 | 0.271 | 0.53 | 16.27 | 0.599 | 0.61 |
| **$KMS_2T_2$** | 21.23 | 0.281 | 0.53 | 21.18 | 0.321 | 0.62 | 21.14 | 0.458 | 0.70 |
| **$KMS_3T_2$** | 19.1 | 0.212 | 0.34 | 19.04 | 0.342 | 0.43 | 19 | 0.407 | 0.51 |
| **$KMS_1T_3$** | 17.59 | 0.220 | 0.45 | 17.53 | 0.370 | 0.54 | 17.48 | 0.679 | 0.62 |
| **$KMS_2T_3$** | 17.86 | 0.237 | 0.48 | 17.81 | 0.323 | 0.57 | 17.76 | 0.657 | 0.65 |
| **$KMS_3T_3$** | 18.92 | 0.250 | 0.51 | 18.87 | 0.313 | 0.60 | 18.84 | 0.447 | 0.68 |
| **CD@5%** | **2.35** | **0.22** | **0.26** | **3.00** | **0.21** | **0.08** | **1.21** | **0.43** | **0.14** |
| **SEM±** | **0.81** | **0.08** | **0.09** | **1.03** | **0.07** | **0.03** | **0.42** | **0.15** | **0.05** |

### 4.3.5 Poly phenol oxidease, Total Soluble Solids and Phenol content of stored sugarcane juice at refrigerated condition

The table 12 show result of effect of KMS and pasteurization temperature on PPO, TSS and phenol content of stored sugarcane juice at refrigerated condition. The lowest and highest values of PPO was found in treatments $KMS_3T_3$ (0.021) & $KMS_1T_1$ (0.028); $KMS_3T_3$ (0.015) & $KMS_1T_1$ (0.025); $KMS_3T_3$ (0.013) & $KMS_1T_1$ (0.024) for 7, 14 and 21 days. Similarly, the lowest and highest values of TSS was seen in treatments $KMS_3T_2$ (18.2) & $KMS_1T_{1,}$ $KMS_2T_3$ (19.8) for 7 days, $KMS_2T_3$ (18.00) & $KMS_1T_{1,}$ $KMS_2T_3$ (19.5) for 14 days and $KMS_3T_2$ (17.70) & $KMS_2T_3$ (19.30) for 21 days. For phenol content the lowest and highest values was seen in treatments: $KMS_3T_{2,}$ (14.54) & $KMS_2T_{2,}$ $KMS_2T_3$ (14.85) for 7 days; $KMS_3T_2$ (14.94) & $KMS_2T_3$ (15.26) for 14 days; $KMS_3T_2$ (15.34) & $KMS_2T_{2,}$ $KMS_2T_3$ (15.65) for 21 days treatments.

The statistical analysis of data indicates that treatments exhibits significant effect on PPO, TSS and phenol content of stored sugarcane juice. Table 12 shows that treatment combination $KMS_1T_1$ was at par to $KMS_2T_1$, $KMS_3T_1$ followed by $KMS_1T_2$ in poly phenol oxidease, similarly in total soluble solid and phenol content, treatment $KMS_1T_1$, $KMS_2T_3$ were at par with $KMS_1T_2$ and $KMS_3T_3$ followed by $KMS_3T_1$; $KMS_2T_2$ was at par with $KMS_3T_1$& $KMS_1T_3$, followed by $KMS_1T_2$ respectively, on 7 days storage of period.

On 14 days of storage period for poly phenol oxidease, treatment $KMS_1T_1$ was at par to $KMS_1T_2$ followed by $KMS_2T_1$; similarly for TSS treatment $KMS_1T_1$ & $KMS_2T_3$ collectively were at par with $KMS_3T_3$ and $KMS_1T_2$; $KMS_2T_3$ was at par to $KMS_2T_2$ followed by $KMS_1T_3$ in phenol content.

Upon 21 days of storage it was seen that for poly phenol oxidease, treatment $KMS_1T_1$ was at par to $KMS_1T_2$ followed by $KMS_2T_1$; for total soluble solid the treatment $KMS_2T_3$ was at par to $KMS_1T_1$ followed by $KMS_3T_1$, for phenol content treatment $KMS_2T_2$ & $KMS_2T_3$ were at par with $KMS_1T_3$, $KMS_3T_1$ followed by $KMS_1T_2$.

**Table 12 Effect of Potassium metabisulfite and pasteurization temperature on poly phenol oxidase (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice at refrigerated condition ($5^0C$)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | PPO | TSS | Phenol | PPO | TSS | Phenol | PPO | TSS | Phenol |
| **$KMS_1T_1$** | 0.028 | 19.8 | 14.62 | 0.025 | 19.5 | 15.02 | 0.024 | 19.2 | 15.42 |
| **$KMS_2T_1$** | 0.026 | 18.5 | 14.55 | 0.023 | 18.3 | 14.95 | 0.021 | 18 | 15.35 |
| **$KMS_3T_1$** | 0.026 | 19.4 | 14.77 | 0.021 | 19.1 | 15.17 | 0.018 | 18.9 | 15.57 |
| **$KMS_1T_2$** | 0.025 | 19.5 | 14.76 | 0.024 | 19.2 | 15.16 | 0.022 | 18.8 | 15.56 |
| **$KMS_2T_2$** | 0.023 | 18.7 | 14.85 | 0.021 | 18.5 | 15.25 | 0.020 | 18.2 | 15.65 |
| **$KMS_3T_2$** | 0.023 | 18.2 | 14.54 | 0.019 | 18 | 14.94 | 0.018 | 17.7 | 15.34 |
| **$KMS_1T_3$** | 0.024 | 18.8 | 14.77 | 0.022 | 18.5 | 15.22 | 0.020 | 18.3 | 15.57 |
| **$KMS_2T_3$** | 0.022 | 19.8 | 14.85 | 0.019 | 19.5 | 15.26 | 0.020 | 19.3 | 15.65 |
| **$KMS_3T_3$** | 0.021 | 19.5 | 14.55 | 0.015 | 19.2 | 15.12 | 0.013 | 18.7 | 15.35 |
| **CD@5%** | **0.02** | **0.16** | **1.44** | **0.02** | **0.07** | **0.05** | **0.02** | **0.05** | **0.05** |
| **SEM±** | **0.01** | **0.05** | **0.50** | **0.01** | **0.03** | **0.02** | **0.01** | **0.02** | **0.02** |

### 4.3.6 Poly phenol oxidease, Total Soluble Solids and Phenol content of stored sugarcane juice at ambient condition

Table 13 comprises the results of effect of potassium meta bisulphite and pasteurization temperature on PPO, TSS and phenol content of stored sugarcane juice at ambient condition. The lowest and highest values of PPO was found in treatments $KMS_3T_3$ (0.034) & $KMS_1T_1$ (0.048); $KMS_3T_3$ (0.025) & $KMS_1T_1$ (0.045); $KMS_3T_3$ (0.027) & $KMS_1T_1$ (0.041) for 7, 14 and 21 days. Similarly TSS was found the lowest and highest ranged in treatments $KMS_3T_2$ (18.20) & $KMS_2T_3$ (19.90) on 7 days of storage period, $KMS_3T_2$ (18.00) & $KMS_2T_3$ (19.70) for 14 days and $KMS_3T_2$ (17.70) & $KMS_2T_3$ (19.50) for 21 days. Phenol content was found to be lowest and highest in treatments: $KMS_3T_{2,}$ (14.14) & $KMS_2T_{2,}$ $KMS_2T_3$ (14.45) for 7 days; $KMS_3T_2$ (14.54) & $KMS_2T_{2,}$ $KMS_2T_3$ (14.85) for 14 days; $KMS_3T_{2,}$ for 21 days of storage period $KMS_3T_2$ (14.95) & $KMS_2T_2$ (15.25).

The statistical analysis of data indicates that significant difference exists among the treatments combinations. The treatment $KMS_1T_1$ was at par to $KMS_2T_1$ followed by $KMS_1T_2$ in poly phenol oxidease, similarly in total soluble solid and phenol content treatment $KMS_2T_1$ was at par with $KMS_2T_1$ and followed by $KMS_3T_3$; $KMS_2T_2$ was at par with $KMS_2T_3$, followed by $KMS_3T_1$ respectively, in 7 days storage of period. On 14 days of storage period for poly phenol oxidease, treatment $KMS_1T_1$ was at par to $KMS_2T_1$ followed by $KMS_2T_2$; in $KMS_2T_3$ was at par with $KMS_1T_1$ & and $KMS_1T_2$; treatment $KMS_2T_2$ was at par to $KMS_2T_3$ followed by $KMS_3T_1$ in phenol content. Finally on 21 days of storage it was seen that treatment $KMS_1T_1$ was at par to $KMS_2T_1$ and $KMS_3T_1$ for poly phenol oxidease; for total soluble solid $KMS_2T_3$ was at par to $KMS_1T_1$ & $KMS_1T_2$ followed by $KMS_3T_1$; as regards for phenol content treatment combination $KMS_2T_2$ was at par with $KMS_2T_3$ followed by $KMS_3T_1$ & $KMS_3T_2$.

**Table 13 Effect of Potassium metabisulfite and pasteurization temperature on poly phenol oxidase (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice at ambient condition (30° C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | PPO | TSS | Phenol | PPO | TSS | Phenol | PPO | TSS | Phenol |
| **$KMS_1T_1$** | 0.048 | 19.5 | 14.22 | 0.045 | 19.3 | 14.62 | 0.041 | 19 | 15.02 |
| **$KMS_2T_1$** | 0.046 | 18.3 | 14.15 | 0.043 | 18.1 | 14.55 | 0.040 | 17.8 | 14.95 |
| **$KMS_3T_1$** | 0.046 | 19.1 | 14.37 | 0.041 | 18.9 | 14.77 | 0.038 | 18.5 | 15.17 |
| **$KMS_1T_2$** | 0.040 | 19.5 | 14.36 | 0.040 | 19.3 | 14.76 | 0.038 | 19 | 15.16 |
| **$KMS_2T_2$** | 0.041 | 18.7 | 14.45 | 0.041 | 18.5 | 14.85 | 0.035 | 18.2 | 15.25 |
| **$KMS_3T_2$** | 0.039 | 18.2 | 14.14 | 0.035 | 18 | 14.54 | 0.031 | 17.7 | 14.94 |
| **$KMS_1T_3$** | 0.037 | 18.5 | 14.37 | 0.032 | 18.3 | 14.77 | 0.031 | 18 | 15.17 |
| **$KMS_2T_3$** | 0.035 | 19.9 | 14.45 | 0.029 | 19.7 | 14.85 | 0.030 | 19.5 | 15.25 |
| **$KMS_3T_3$** | 0.034 | 19.2 | 14.15 | 0.025 | 19 | 14.55 | 0.027 | 18.7 | 14.95 |
| **CD@5%** | **0.02** | **0.05** | **0.05** | **0.02** | **0.47** | **0.04** | **0.03** | **0.07** | **0.56** |
| **SEM±** | **0.01** | **0.02** | **0.01** | **0.01** | **0.16** | **0.01** | **0.01** | **0.02** | **0.19** |

### 4.4 Effect of effect of potassium sorbate and pasteurization temperature on chemical composition of stored sugarcane juice

#### 4.4.1 Moisture, Carbohydrate and Total ash content stored sugarcane juice at refrigerated condition.

The result presented in table 14 shows the effect of potassium sorbate and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at refrigerated condition. The lowest and highest values of moisture content was found in treatments $PS_3T_1$ (75.90) & $PS_3T_3$ (81.20); $PS_3T_2$ (77.20) & $PS_1T_3$ (84.63); $PS_2T_1$ (76.79) & $PS_1T_3$ (80.79) for 7, 14 and 21 days of storage of sugarcane juice. Similarly it was observed that carbohydrate content was found to be lowest and highest in treatments combinations $PS_1T_1$ (13.50) & $PS_3T_1$ (16.74) for 7 days, $PS_1T_2$ (13.06) & $PS_1T_3$ (16.88) for 14 days and $PS_2T_2$ (13.92) & $PS_1T_3$ (17.23) for 21 days storage of sugarcane juice. As regards for total ash content the lowest and highest values were observed in treatments: $PS_3T_1$, $PS_3T_2$, $PS_3T_3$ (0.20) & $PS_2T_1$, $PS_1T_2$, $PS_2T_2$, $PS_2T_3$ (0.40) for 7 days; $PS_1T_1$, $PS_1T_3$, $PS_3T_3$ (0.20) & $PS_2T_1$, $PS_3T_1$, $PS_3T_2$, $PS_2T_3$ (0.40) for 14 days; $PS_1T_1$, $PS_3T_1$, $PS_1T_2$, $PS_1T_3$, $PS_3T_3$ (0.20) & $PS_2T_1$, $PS_2T_2$, $PS_3T_2$ (0.40) for 21 days storage of juice.

The statistical analysis shows that treatment combination has got significant effect on chemical constituents of stored sugarcane juice. Treatment combination $PS_3T_3$ was at par to $PS_2T_3$ followed by $PS_1T_2$ in moisture content, similarly in carbohydrate and ash content treatment, $PS_3T_1$ was at par with $PS_2T_1$ and followed by $PS_3T_2$; $PS_2T_1$ was at par with $PS_1T_2$, followed by $PS_1T_1$ respectively, in 7 days storage of period.

On 14 days of storage period, for moisture content, treatment $PS_3T_3$ was at par to $PS_2T_3$ followed by $PS_3T_1$; $PS_1T_3$ was at par with $PS_3T_3$ & followed by $PS_3T_1$; treatment $PS_2T_1$ was at par to $PS_3T_1$ followed by $PS_1T_2$ in ash content.

Finally on 21 days of storage study, it was seen that treatment $PS_1T_3$ was at par to $PS_1T_2$ and $PS_2T_3$ for moisture; for carbohydrate $PS_1T_3$ was at par to $PS_1T_2$ & followed by $PS_1T_1$; in ash content treatment combination $PS_2T_1$ was at par with $PS_2T_2$ followed by $PS_2T_3$.

**Table 14 Effect of Potassium sorbate and pasteurization temperature on moisture, carbohydrate and ash of stored sugarcane juice at refrigerated condition (5°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash |
| $PS_1T_1$ | 76.1 | 13.5 | 0.3 | 80.88 | 13.41 | 0.2 | 76.82 | 16.01 | 0.2 |
| $PS_2T_1$ | 76.6 | 14.46 | 0.4 | 80.5 | 13.73 | 0.4 | 76.4 | 14.52 | 0.4 |
| $PS_3T_1$ | 75.9 | 16.74 | 0.2 | 81.43 | 15.82 | 0.4 | 79.22 | 14.46 | 0.2 |
| $PS_1T_2$ | 76.75 | 13.97 | 0.4 | 81.23 | 13.06 | 0.3 | 80.78 | 17.16 | 0.2 |
| $PS_2T_2$ | 76.1 | 13.87 | 0.4 | 80.9 | 14.78 | 0.3 | 80.1 | 13.92 | 0.4 |
| $PS_3T_2$ | 76.1 | 14.21 | 0.2 | 77.2 | 14.94 | 0.4 | 79.22 | 15.06 | 0.4 |
| $PS_1T_3$ | 76.55 | 13.97 | 0.3 | 80.5 | 16.88 | 0.2 | 80.79 | 17.23 | 0.2 |
| $PS_2T_3$ | 78.35 | 13.87 | 0.4 | 82.25 | 14.78 | 0.4 | 80.6 | 14.41 | 0.3 |
| $PS_3T_3$ | 81.2 | 14.21 | 0.2 | 84.63 | 16.40 | 0.2 | 80.25 | 16.01 | 0.2 |
| **CD@5%** | **0.60** | **0.07** | **0.05** | **0.51** | **0.06** | **0.03** | **0.36** | **0.29** | **0.06** |
| **SEM±** | **0.21** | **0.02** | **0.02** | **0.18** | **0.02** | **0.01** | **0.12** | **0.10** | **0.02** |

### 4.4.2 Moisture, Carbohydrate and Total ash content stored sugarcane juice at ambient condition.

The effect of potassium sorbate and pasteurization temperature on moisture, carbohydrate and ash of stored sugarcane juice at ambient condition is presented in table 15. The lowest and highest values of moisture content was found in treatments combination $PS_3T_2$ (76.58) & $PS_3T_3$ (80.57); $PS_3T_2$ (77.85) & $PS_3T_3$ (83.47); $PS_1T_1$ (76.72) & $PS_3T_2$ (81.75) for 7, 14 and 21 days of storage study of sugarcane juice. Similarly it was also observed that, carbohydrate content was found to be lowest and highest range in treatment combination $PS_3T_1$ (13.78) & $PS_3T_3$ (15.76) for 7 days, $PS_2T_1$ (13.73) & $PS_2T_2$ (17.16) for 14 days and $PS_2T_3$ (13.92) & $PS_2T_2$ (17.84) for 21 days of storage of sugarcane juice. The ash content was found to be lowest and highest in treatment combinations $PS_2T_1$, $PS_2T_2$, $PS_1T_3$, $PS_2T_3$ (0.20) & $PS_3T_1$, $PS_1T_2$, $PS_3T_2$, $PS_3T_3$ (0.40) for 7 days; $PS_1T_1$, $PS_2T_2$, $PS_1T_3$ (0.20) & $PS_3T_1$, $PS_1T_2$, $PS_3T_2$, $PS_2T_3$, $PS_3T_3$ (0.40) for 14 days; $PS_1T_1$, $PS_3T_1$, $PS_2T_2$, $PS_2T_3$, $PS_3T_3$ (0.20) & $PS_1T_1$, $PS_3T_2$, $PS_1T_3$ (0.40) for 21 days storage study.

The statistical analysis shows that treatment combination $PS_3T_3$ was at par to $PS_1T_1$ followed by $PS_2T_3$ in moisture, similarly in carbohydrate and ash content treatment $PS_3T_3$ was at par with $PS_3T_2$ and followed by $PS_1T_2$; $PS_1T_2$ was at par with $PS_1T_1$, followed by $PS_2T_1$ respectively, in 7 days storage of period.

On 14 days of storage period for moisture content, treatment $PS_3T_3$ was at par to $PS_2T_3$ followed by $PS_2T_2$; in $PS_2T_2$ was at par with $PS_1T_1$ & followed by $PS_3T_2$; treatment $PS_3T_1$ was at par to $PS_2T_1$ followed by $PS_1T_1$ in case of ash content.

Upon 21 days of storage study, it was seen that treatment $PS_3T_2$ was at par to $PS_1T_2$ and followed by $PS_2T_3$ for moisture; for carbohydrate $PS_3T_2$ was at par to $PS_1T_3$ & followed by $PS_2T_2$; for ash content treatment combination $PS_1T_1$ was at par with $PS_3T_1$ followed by $PS_2T_2$.

**Table 15 Effect of Potassium sorbate and pasteurization temperature on moisture, carbohydrate and ash of stored sugarcane juice at ambient condition (30°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash |
| $PS_1T_1$ | 78.01 | 14.16 | 0.3 | 80.72 | 14.57 | 0.2 | 76.72 | 14.16 | 0.4 |
| $PS_2T_1$ | 76.75 | 13.92 | 0.2 | 80.50 | 13.73 | 0.3 | 77.54 | 12.19 | 0.3 |
| $PS_3T_1$ | 76.80 | 13.78 | 0.4 | 81.78 | 13.78 | 0.4 | 81.21 | 15.76 | 0.3 |
| $PS_1T_2$ | 77.10 | 14.46 | 0.4 | 81.75 | 13.82 | 0.4 | 81.52 | 17.59 | 0.4 |
| $PS_2T_2$ | 78.00 | 14.11 | 0.2 | 82.40 | 17.16 | 0.2 | 80.00 | 17.84 | 0.2 |
| $PS_3T_2$ | 76.58 | 15.46 | 0.4 | 77.85 | 14.26 | 0.4 | 81.75 | 19.1 | 0.4 |
| $PS_1T_3$ | 76.70 | 13.82 | 0.2 | 81.12 | 14.21 | 0.2 | 80.50 | 18.16 | 0.4 |
| $PS_2T_3$ | 78.00 | 13.92 | 0.2 | 82.76 | 17.16 | 0.4 | 81.42 | 13.92 | 0.2 |
| $PS_3T_3$ | 80.57 | 15.76 | 0.4 | 83.47 | 13.78 | 0.4 | 80.50 | 14.84 | 0.2 |
| **CD@5%** | **0.47** | **0.10** | **0.06** | **0.63** | **0.28** | **0.48** | **0.43** | **0.39** | **0.05** |
| **SEM±** | **0.16** | **0.04** | **0.02** | **0.22** | **0.81** | **0.17** | **0.15** | **0.13** | **0.02** |

### 4.4.3 Total sugar, reducing sugar and titrable acidity stored sugarcane juice at refrigerated condition

Table 16 shows the effect of potassium sorbate and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition. The results indicates that lowest and highest values of total sugar was found in treatments $PS_1T_1$ (76.58) & $PS_1T_2$ (80.57); $PS_1T_1$ (77.85) & $PS_1T_2$ (83.47); $PS_1T_1$ (76.72) & $PS_1T_2$ (81.75) for 7, 14 and 21 days. Similarly observed the reducing sugar was found the lowest and highest ranged in treatments $PS_3T_1$ (13.78) & $PS_3T_3$ (15.76) for 7 days, $PS_3T_1$ (13.73) & $PS_3T_2$ (17.16) for 14 days and $PS_2T_1$ (13.92) & $PS_3T_1$ (17.84) for 21 days. Finally, for reducing sugar was found the lowest and highest values in treatments: $PS_2T_1$ (0.20) & $PS_3T_1$ (0.40) for 7 days; $PS_2T_1$ (0.20) & $PS_3T_1$ (0.40) for 14 days; $PS_2T_1$ (0.20) & $PS_3T_1$ (0.40) for 21 days treatments.

On CRD analysis all the treatments were found significant. Treatment $PS_1T_2$ was at par to $PS_2T_2$ followed by $PS_3T_2$ in total sugar, similarly in reducing sugar and titrable acidity treatment $PS_3T_3$ was at par with $PS_1T_2$ and followed by $PS_2T_2$; $PS_2T_1$ was at par with $PS_2T_2$, followed by $PS_2T_3$ respectively, in 7 days storage of period.

On 14 days of storage period for total sugar, treatment $PS_1T_2$ was at par to $PS_2T_2$ followed by $PS_3T_2$; in $PS_2T_1$ was at par with $PS_2T_2$ & followed by $PS_1T_2$; treatment $PS_2T$ was at par to $PS_2T_2$ followed by $PS_1T_2$ in titrable acidity.

Finally on 21 days of storage it was seen that treatment $PS_1T_2$ was at par to $PS_2T_2$ and followed by $PS_3T_2$ for total sugar; Reducing $PS_2T_2$ was at par to $PS_2T_1$ & followed by $PS_3T_1$; In titrable acidity treatment $PS_2T_1$ was at par with $PS_3T_3$ followed by $PS_2T_2$.

### 4.4.4 Total sugar, reducing sugar and titrable acidity stored sugarcane juice at ambient condition.

Table 17 indicates the effect of potassium sorbate and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition. The minimum and maximum value of total sugar was seen in treatments $PS_1T_1$ (15.21) &$PS_1T_2$ (21.88); $PS_1T_1$

**Table 16 Effect of Potassium sorbate and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition (5°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity |
| **$PS_1T_1$** | 14.47 | 0.209 | 0.36 | 14.36 | 0.313 | 0.45 | 14.31 | 0.407 | 0.53 |
| **$PS_2T_1$** | 19.49 | 0.219 | 0.52 | 19.36 | 0.299 | 0.61 | 19.32 | 0.599 | 0.69 |
| **$PS_3T_1$** | 19.1 | 0.204 | 0.27 | 19.04 | 0.271 | 0.36 | 19 | 0.582 | 0.43 |
| **$PS_1T_2$** | 22.62 | 0.256 | 0.42 | 22.56 | 0.318 | 0.51 | 22.5 | 0.550 | 0.48 |
| **$PS_2T_2$** | 20.49 | 0.251 | 0.51 | 20.36 | 0.339 | 0.60 | 20.31 | 0.657 | 0.67 |
| **$PS_3T_2$** | 19.91 | 0.214 | 0.32 | 19.86 | 0.342 | 0.41 | 19.82 | 0.468 | 0.49 |
| **$PS_1T_3$** | 15.79 | 0.205 | 0.44 | 15.74 | 0.318 | 0.53 | 15.7 | 0.509 | 0.61 |
| **$PS_2T_3$** | 17.53 | 0.247 | 0.49 | 17.47 | 0.295 | 0.58 | 17.42 | 0.452 | 0.66 |
| **$PS_3T_3$** | 18.11 | 0.263 | 0.52 | 18.04 | 0.279 | 0.61 | 17.99 | 0.503 | 0.69 |
| **CD@5%** | **0.49** | **0.05** | **0.32** | **0.79** | **0.08** | **0.38** | **0.53** | **0.05** | **0.06** |
| **SEM±** | **0.17** | **0.02** | **0.11** | **0.27** | **0.03** | **0.13** | **0.18** | **0.02** | **0.02** |

**Table 17 Effect of Potassium sorbate and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition (30°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity |
| **$PS_1T_1$** | 15.21 | 0.212 | 0.53 | 15.15 | 0.275 | 0.62 | 15.11 | 0.558 | 0.70 |
| **$PS_2T_1$** | 18.17 | 0.234 | 0.46 | 18.13 | 0.299 | 0.55 | 18.08 | 0.590 | 0.63 |
| **$PS_3T_1$** | 16.53 | 0.255 | 0.49 | 16.48 | 0.326 | 0.58 | 16.43 | 0.582 | 0.66 |
| **$PS_1T_2$** | 21.88 | 0.204 | 0.40 | 21.84 | 0.283 | 0.49 | 21.8 | 0.599 | 0.57 |
| **$PS_2T_2$** | 15.79 | 0.206 | 0.46 | 15.74 | 0.374 | 0.55 | 15.7 | 0.458 | 0.63 |
| **$PS_3T_2$** | 16.53 | 0.231 | 0.49 | 16.47 | 0.370 | 0.58 | 16.42 | 0.407 | 0.66 |
| **$PS_1T_3$** | 17.53 | 0.248 | 0.28 | 17.48 | 0.258 | 0.27 | 17.43 | 0.497 | 0.35 |
| **$PS_2T_3$** | 21.88 | 0.220 | 0.47 | 21.83 | 0.291 | 0.56 | 21.78 | 0.424 | 0.64 |
| **$PS_3T_3$** | 18.17 | 0.226 | 0.41 | 18.13 | 0.357 | 0.50 | 18.06 | 0.452 | 0.58 |
| **CD@5%** | **0.58** | **0.06** | **0.06** | **0.97** | **0.06** | **0.05** | **1.09** | **0.08** | **0.07** |
| **SEM±** | **0.20** | **0.02** | **0.02** | **033** | **0.02** | **0.02** | **0.37** | **0.03** | **0.02** |

(15.15) &$PS_1T_2$ (21.84); $PS_1T_2$ (21.8) & $PS_2T_2$ (15.7) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of reducing sugar were found in treatments $PS_3T_1$ (0.255) & $PS_1T_2$ (0.204), for 7 days, $PS_1T_2$ (21.84) & $PS_1T_1$, (15.15) for 14 days and $PS_3T_2$ (0.407) & $PS_1T_2$ (0.599) for 21 days.

Finally, for the titrable acidity higher and lower values were as follows: $PS_1T_3$ (0.28), $PS_1T_1$ (0.53); $PS_1T_3$ (0.27) & $PS_1T_3$; $PS_1T_3$ (0.35) and $PS_1T_1$ (0.70) for 7 days

On CRD analysis all the treatments were found significant. Treatment $PS_1T_2$ was at par to $PS_2T_3$ followed by $PS_2T_1$ in total sugar, similarly in reducing sugar and titrable acidity treatment $PS_3T_1$ was at par with $PS_1T_3$ and followed by $PS_2T_2$; $PS_1T_1$ was at par with $PS_3T_1$ followed by $PS_3T_2$ respectively, in 7 days storage of period.

On 14 days of storage period for total sugar, treatment $PS_1T_2$ was at par to $PS_2T_3$ followed by $PS_2T_1$; in $PS_2T_2$ was at par with $PS_3T_3$ & followed by $PS_1T_1$; treatment $PS_1T_1$ was at par to $PS_3T_1$ followed by $PS_3T_2$ in titrable acidity.

Finally on 21 days of storage it was seen that treatment $PS_1T_2$ was at par to $PS_2T_3$ and followed by $PS_2T_1$ for total sugar; Reducing $PS_1T_2$ was at par to $PS_2T_1$ & followed by $PS_3T_1$; in titrable acidity treatment $PS_1T_1$ was at par with $PS_3T_1$ followed by $PS_3T_2$.

### 4.4.5 Poly phenol oxidease (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice at refrigerated condition

Table 18 reveals that minimum and maximum value of poly phenol oxidease, in treatments $PS_3T_3$ (0.031) & $PS_1T_1$ (0.035); $PS_3T_3$ (0.025) &$PS_1T_1$ (0.029); $PS_3T_3$ (0.023) & $PS_1T_1$ (0.028) for 7, 14 and 21 days of storage period of sugarcane juice respectively. Similarly the lowest and highest values of total soluble solid were found in treatments $PS_1T_1$ (18.3) & $PS_2T_3$ (20.7), for 7 days, $PS_1T_1$ (18.0) & $PS_3T_3$, (20.5) for 14 days and $PS_1T_1$ (17.8) & $PS_1T_2$ (20.2) for 21 days of storage period. The phenol content was higher and lower in treatment combination: $PS_1T_1$ (18.3) & $PS_2T_3$ (20.7); $PS_1T_1$ (14.92) & $PS_3T_1$ (15.27); $PS_1T_1$ (15.32) $PS_3T_1$ (15.67) for 7, 14 and 21 days respectively

**Table 18 Effect of Potassium sorbate and pasteurization temperature on poly phenol oxidase (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice at refrigerated condition (5°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | PPO | TSS | Phenol | PPO | TSS | Phenol | PPO | TSS | Phenol |
| $PS_1T_1$ | 0.035 | 18.3 | 14.52 | 0.029 | 18 | 14.92 | 0.028 | 17.8 | 15.32 |
| $PS_2T_1$ | 0.033 | 18.7 | 14.74 | 0.028 | 18.5 | 15.14 | 0.027 | 18.3 | 15.54 |
| $PS_3T_1$ | 0.032 | 19.7 | 14.87 | 0.028 | 19.5 | 15.27 | 0.027 | 19.3 | 15.67 |
| $PS_1T_2$ | 0.032 | 19.1 | 14.82 | 0.027 | 18.8 | 15.22 | 0.027 | 18.5 | 15.62 |
| $PS_2T_2$ | 0.031 | 19.8 | 14.64 | 0.027 | 19.5 | 15.04 | 0.025 | 19.2 | 15.44 |
| $PS_3T_2$ | 0.033 | 18.5 | 14.78 | 0.026 | 18.3 | 15.18 | 0.026 | 18 | 15.58 |
| $PS_1T_3$ | 0.031 | 20 | 14.64 | 0.026 | 19.8 | 15.05 | 0.024 | 19.6 | 15.44 |
| $PS_2T_3$ | 0.031 | 20.7 | 14.54 | 0.025 | 20.5 | 15.03 | 0.024 | 20.2 | 15.34 |
| $PS_3T_3$ | 0.031 | 18.4 | 14.59 | 0.025 | 18.2 | 15.15 | 0.023 | 17.9 | 15.39 |
| **CD@5%** | **0.03** | **0.40** | **0.08** | **0.02** | **0.88** | **0.70** | **0.03** | **0.72** | **0.04** |
| **SEM±** | **0.01** | **0.14** | **0.03** | **0.01** | **0.30** | **0.24** | **0.01** | **0.25** | **0.01** |

Table 18 indicate that treatment combination $PS_1T_1$ was at par to $PS_2T_1$ followed by $PS_3T_1$ in poly phenol oxidease activity similarly in total soluble solid and phenol content treatment $PS_2T_3$ was at par with $PS_1T_3$ and followed by $PS_2T_2$; $PS_3T_1$ was at par with $PS_1T_2$ followed by $PS_3T_2$ respectively, in 7 days storage of period.

On 14 days of storage period for poly phenol oxidease, treatment $PS_1T_1$ was at par to $PS_2T_1$ followed by $PS_1T_2$; in $PS_2T_3$ was at par with $PS_1T_3$ & followed by $PS_3T_1$; treatment $PS_1T_2$ was at par to $PS_3T_1$ followed by $PS_2T_1$ in phenol content.

Finally on 21 days of storage of sugarcane juice, it was seen that treatment $PS_1T_1$ was at par to $PS_2T_1$ and followed by $PS_3T_2$ for poly phenol oxidease; total soluble solid $PS_2T_3$ was at par to $PS_1T_3$ & followed by $PS_3T_1$; in phenol content treatment combination $PS_3T_1$ was at par with $PS_1T_2$ followed by treatment $PS_3T_2$.

### 4.4.6 Poly phenol oxidease (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice at ambient condition

Table 19 indicates that minimum and maximum value of poly phenol oxidease, was seen in treatments $PS_3T_3$ (0.029) & $PS_1T_1$ (0.035); $PS_3T_3$ (0.025) & $PS_1T_1$ (0.032); $PS_3T_3$ (0.025) & $PS_1T_1$ (0.032) for 7, 14 and 21 days respectively. The lowest and highest range of the total soluble solid were seen in treatments $PS_3T_3$ (18.2) & $PS_2T_3$ (20.5), for 7 days, $PS_3T_3$18.0) & $PS_2T_3$, (20.2) for 14 days and $PS_2T_1$ (18.0) & $PS_2T_3$ (19.5) for 21 days. The phenol content was higher and lower in treatment combination $PS_3T_1$ (14.47) & $PS_1T_1$ (14.12) ; $PS_3T_1$ (14.87),& $PS_1T_1$(14.52); $PS_3T_1$ (15.27)$PS_1T_1$ (14.92) for 7 ,14 and 21 days respectively.

Table 19 also indicates that treatment combination $PS_1T_1$ was at par to $PS_3T_1$ followed by $PS_1T_2$ in poly phenol oxidease, similarly in total soluble solid and phenol content, treatment $PS_2T_3$ was at par with $PS_2T_2$ and followed by $PS_1T_3$; $PS_3T_1$ was at par with $PS_1T_2$ followed by $PS_3T_2$ respectively, in 7 days storage of period.

On 14 days of storage period for poly phenol oxidease, treatment $PS_1T_1$ was at par to $PS_1T_2$ followed by $PS_2T_1$; in $PS_2T_3$ was at par with $PS_2T_2$

**Table 19 Effect of Potassium sorbate and pasteurization temperature on poly phenol oxidase (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice at ambient condition (30° C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | PPO | TSS | Phenol | PPO | TSS | Phenol | PPO | TSS | Phenol |
| $PS_1T_1$ | 0.0350 | 18.7 | 14.12 | 0.032 | 18.5 | 14.52 | 0.032 | 18.2 | 14.92 |
| $PS_2T_1$ | 0.0350 | 18.5 | 14.34 | 0.030 | 18.3 | 14.74 | 0.030 | 18 | 15.14 |
| $PS_3T_1$ | 0.0348 | 19.5 | 14.47 | 0.030 | 19.3 | 14.87 | 0.030 | 19 | 15.27 |
| $PS_1T_2$ | 0.033 | 19.7 | 14.42 | 0.031 | 19.5 | 14.82 | 0.031 | 19.2 | 15.22 |
| $PS_2T_2$ | 0.034 | 19.9 | 14.24 | 0.030 | 19.7 | 14.64 | 0.030 | 19.3 | 15.04 |
| $PS_3T_2$ | 0.034 | 18.5 | 14.38 | 0.029 | 18.2 | 14.78 | 0.029 | 17.9 | 15.18 |
| $PS_1T_3$ | 0.031 | 19.8 | 14.24 | 0.027 | 19.4 | 14.64 | 0.027 | 18 | 15.04 |
| $PS_2T_3$ | 0.03 | 20.5 | 14.14 | 0.025 | 20.2 | 14.54 | 0.025 | 19.5 | 14.94 |
| $PS_3T_3$ | 0.029 | 18.2 | 14.19 | 0.025 | 18 | 14.59 | 0.025 | 18.7 | 14.99 |
| **CD@5%** | **0.03** | **0.86** | **0.66** | **0.03** | **0.05** | **1.11** | **0.03** | **0.88** | **0.87** |
| **SEM±** | **0.01** | **0.30** | **0.23** | **0.01** | **0.02** | **0.38** | **0.01** | **0.30** | **0.30** |

& followed by $PS_1T_2$; treatment $PS_3T_1$ was at par to $PS_1T_2$ followed by $PS_3T_2$ in phenol content.

Finally on 21 days of storage it was seen that treatment $PS_1T_1$ was at par to $PS_1T_2$ and followed by $PS_2T_1$ for poly phenol oxidease; Total soluble solid $PS_2T_3$ was at par to $PS_2T_2$ & followed by $PS_1T_2$; in phenol content treatment $PS_3T_1$ was at par with $PS_1T_2$ followed by $PS_3T_2$.

## 4.5. Effect of different combinations of ascorbic acid and pasteurization temperature on various chemical constituents of stored sugar cane juice

### 4.5.1 Moisture, Carbohydrate and Ash content of stored sugar cane juice at refrigerated condition

Table 20 comprises the results of effect of different combinations of ascorbic acid and pasteurization temperature on various chemical constituents of stored sugar cane juice. The minimum and maximum value of moisture, carbohydrate and ash content under refrigerated condition (Table 20) was seen in treatments $AA_2T_1$ (75.4) & $AA_2T_3$ (81.2); $AA_1T_2$ (76.54) & $AA_3T_3$ (85.6); $AA_2T_1$ (76.24) & $AA_1T_3$ (82.25) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of carbohydrate were found in treatments $AA_1T_3$ (13.73) & $AA_3T_3$ (16.27), for 7 days, $AA_2T_1$ (13.59) & $AA_2T_2$, (15.70) for 14 days and $AA_3T_2$ (17.23) & $AA_1T_3$ (13.73) for 21 days. Finally, for the Ash content higher and lower values were as follows: $AA_1T_2$, $AA_3T_3$, (0.4) and $AA_1T_1$, $AA_2T_2$ $AA_3T_2$ $AA_2T_3$ (0.2) for 7 days; $AA_2T_2$ (0.6) & $AA_1T_1$, $AA_3T_2$, $AA_1T_3$ (0.2) for 14 days; $AA_1T_1$ & $AA_2T_2$ (0.6) & $AA_3T_2$, $AA_1T_3$, $AA_2T_3$, (0.2) for 21 day.

The statistical analysis shows that treatment $AA_2T_3$ was at par to $AA_3T_3$ followed by $AA_1T_2$ in moisture, similarly in carbohydrate and ash content treatment $AA_3T_3$ was at par with $AA_2T_2$ and followed by $AA_2T_3$; $AA_1T_2$ was at par with $AA_3T_3$, followed by $AA_1T_3$ respectively, in 7 days storage of period.

On 14 days of storage period for moisture, treatment $AA_3T_3$ was at par to $AA_3T_2$ followed by $AA_2T_3$; in $AA_2T_2$ was at par with $AA_3T_1$ & followed by $AA_1T_2$; treatment $AA_2T_2$ was at par to $AA_3T_1$ followed by $AA_2T_3$ in ash content.

**Table 20 Effect of ascorbic acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at refrigerated condition (5°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash |
| $AA_1T_1$ | 76.2 | 13.82 | 0.2 | 80.12 | 14.26 | 0.2 | 76.7 | 14.94 | 0.6 |
| $AA_2T_1$ | 75.4 | 14.41 | 0.3 | 80.55 | 13.59 | 0.3 | 76.24 | 14.78 | 0.4 |
| $AA_3T_1$ | 75.61 | 14.31 | 0.3 | 82.2 | 13.78 | 0.4 | 80.12 | 16.40 | 0.3 |
| $AA_1T_2$ | 76.75 | 13.78 | 0.4 | 76.54 | 14.73 | 0.3 | 80.5 | 13.92 | 0.4 |
| $AA_2T_2$ | 79.1 | 15.82 | 0.2 | 82.81 | 15.70 | 0.6 | 81.66 | 13.97 | 0.6 |
| $AA_3T_2$ | 76.4 | 13.92 | 0.2 | 84.6 | 13.78 | 0.2 | 80.55 | 17.23 | 0.2 |
| $AA_1T_3$ | 76.54 | 13.73 | 0.3 | 76.75 | 13.73 | 0.2 | 82.25 | 13.73 | 0.2 |
| $AA_2T_3$ | 81.2 | 14.57 | 0.2 | 84.6 | 14.84 | 0.4 | 80.9 | 14.57 | 0.2 |
| $AA_3T_3$ | 78.35 | 16.27 | 0.4 | 85.6 | 15 | 0.3 | 81.66 | 14.36 | 0.3 |
| **CD@5%** | **0.85** | **0.03** | **0.04** | **0.65** | **0.06** | **0.04** | **0.99** | **0.88** | **0.05** |
| **SEM±** | **0.29** | **0.01** | **0.01** | **0.22** | **0.02** | **0.01** | **0.34** | **0.30** | **0.02** |

Finally on 21 days of storage it was seen that treatment $AA_1T_3$ was at par to $AA_2T_2$ and followed by $AA_2T_3$ for moisture; for carbohydrate $AA_3T_2$ was at par to $AA_3T_1$ & followed by $AA_1T_1$; in ash content treatment $AA_1T_1$ was at par with $AA_2T_1$ followed by $AA_3T_1$.

### 4.5.2 Moisture, Carbohydrate and Ash content of stored sugar cane juice at ambient condition

Table 21 shows that highest and lowest moisture content were found in treatments $AA_2T_3$ (76.32) & $AA_2T_3$ (78.00); $AA_3T_2$ (78.00) & $AA_3T_3$ (84.60); $AA_2T_1$ (75.50) & $AA_3T_{2,}$ $AA_3T_3$ (81.40) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of carbohydrate were found in treatments $AA_2T_2$ (13.64) & $AA_1T_3$ (16.67), for 7 days, $AA_3T_2$ (13.59) & $AA_3T_{1,}$ (16.53) for 14 days and $AA_3T_1$ (13.92) & $AA_2T_3$ (18.41) for 21 days storage of sugarcane juice. The ash content was higher and lower in treatments viz $AA_1T_1$, $AA_2T_{2,}$ $AA_1T_3$ (0.4) and $AA_2T_{1,}$ $AA_3T_1$ $AA_1T_2$ $AA_3T_2$ $AA_2T_3$ $AA_3T_3$ (0.2) for 7 days; $AA_2T_{1,}$ $AA_3T_1$, $AA_3T_{2,}$ $AA_2T_3$ (0.4) & $AA_1T_{2,}$ $AA_1T_3$, $AA_3T_3$ (0.2) for 14 days; $AA_1T_2$ & $AA_2T_2$, $AA_1T_3$ (0.4) & $AA_1T_{1,}$ $AA_3T_2$, $AA_1T_3$, $AA_2T_{3,}$ $AA_3T_3$ (0.2) for 21 day respectively.

Findings exhibits that treatments have got significant effect on chemical composition of juice. Treatment $AA_2T_3$ was at par to $AA_2T_2$ followed by $AA_3T_3$ for moisture, similarly in carbohydrate and ash content treatment $AA_1T_3$ was at par with $AA_1T_1$ and followed by $AA_3T_3$; $AA_1T_1$ was at par with $AA_2T_2$, followed by $AA_2T_1$ respectively, in 7 days storage of period.

On 14 days of storage period, for moisture content treatment combination $AA_1T_3$ was at par to $AA_2T_2$ followed by $AA_1T_2$; in $AA_3T_1$ was at par with $AA_3T_3$ & followed by $AA_1T_1$; treatment $AA_2T_1$ was at par to $AA_3T_1$ followed by $AA_1T_1$ in ash content.

On 21 days of storage study, it was seen that treatment $AA_3T_2$ was at par to $AA_3T_3$ and followed by $AA_2T_2$ for moisture; for carbohydrate $AA_2T_3$ was at par to $AA_3T_2$ & followed by $AA_1T_1$; in ash content treatment $AA_1T_2$ was at par with $AA_2T_1$ followed by $AA_1T_1$.

**Table 21 Effect of ascorbic acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at ambient condition (30°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash | Moisture | Carbohydrate | Ash |
| **$AA_1T_1$** | 76.50 | 14.67 | 0.4 | 80.12 | 14.52 | 0.3 | 76.80 | 17.23 | 0.2 |
| **$AA_2T_1$** | 76.82 | 13.82 | 0.2 | 80.40 | 14.21 | 0.4 | 76.50 | 14.52 | 0.3 |
| **$AA_3T_1$** | 76.80 | 13.97 | 0.2 | 81.30 | 16.53 | 0.4 | 80.50 | 13.92 | 0.2 |
| **$AA_1T_2$** | 76.50 | 13.73 | 0.2 | 81.12 | 14.01 | 0.2 | 80.70 | 16.33 | 0.4 |
| **$AA_2T_2$** | 77.10 | 13.64 | 0.4 | 81.70 | 13.92 | 0.3 | 81.21 | 14.21 | 0.4 |
| **$AA_3T_2$** | 76.62 | 14.41 | 0.2 | 78.00 | 13.59 | 0.4 | 81.40 | 18.33 | 0.3 |
| **$AA_1T_3$** | 76.32 | 16.67 | 0.4 | 84.60 | 13.82 | 0.2 | 80.75 | 14.26 | 0.4 |
| **$AA_2T_3$** | 78.00 | 14.52 | 0.2 | 81.30 | 13.78 | 0.4 | 80.14 | 18.41 | 0.2 |
| **$AA_3T_3$** | 76.91 | 14.41 | 0.2 | 84.60 | 14.89 | 0.2 | 81.40 | 16.40 | 0.2 |
| **CD@5%** | **0.65** | **0.06** | **0.06** | **1.09** | **0.04** | **0.05** | **0.96** | **0.47** | **0.06** |
| **SEM±** | **0.22** | **0.02** | **0.02** | **0.37** | **0.01** | **0.02** | **0.33** | **0.16** | **0.02** |

### 4.5.3 Total sugar, reducing sugar and Titrable acidity of stored sugarcane juice at refrigerated condition

Table 22 reveals the effect of ascorbic acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition. The minimum and maximum value of total sugar was seen in treatments $AA_3T_1$, (22.62) & $AA_1T_3$ (15.63); $AA_3T_{1,}$ (22.57) & $AA_1T_3$ (15.18); $AA_2T_1$ (22.53) & $AA_1T_3$ (15.47) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of reducing sugar were found in treatments $AA_2T_3$ (0.247) & $AA_1T_2$ (0.204) for 7 days, $AA_3T_2$ (0.370) & $AA_3T_1$ (0.258) for 14 days and $AA_3T_1$ (22.53) & $AA_1T_3$ (15.47) for 21 days. Finally, for titrable acidity the higher and lower values were as follows: $AA_1T_1$ (0.51) & $AA_3T_3$ (0.26), for 7 days; $AA_1T_1$ (0.60) & $AA_3T_3$ (0.35) for 14 days; $AA_3T_1$ (0.67) & $AA_3T_3$ (0.45) for 21 days.

The statistical analysis of data shows significant effect of treatments on quality of juice. The treatment combination $AA_3T_1$ was at par to $AA_3T_3$ followed by $AA_1T_2$ for total sugar, similarly in case of reducing sugar and titrable acidity treatment $AA_2T_3$ was at par with $AA_2T_2$ and followed by $AA_3T_1$; $AA_1T_1$ was at par with $AA_3T_1$, followed by $AA_3T_2$ respectively, in 7 days storage of period.

On 14 days of storage period, for total sugar, treatment $AA_3T_1$ was at par to $AA_2T_1$ followed by $AA_1T_2$; in $AA_3T_2$ was at par with $AA_2T_2$ & followed by $AA_1T_2$; treatment $AA_1T_1$ was at par to $AA_3T_1$ followed by $AA_3T_2$ in titrable acidity. Finally on 21 days of storage it was seen that treatment $AA_3T_1$ was at par to $AA_2T_1$ and followed by $AA_2T_2$ for total sugar; for reducing sugar $AA_1T_1$ was at par to $AA_2T_2$ & followed by $AA_3T_1$; in titrable acidity treatment $AA_3T_1$ was at par with $AA_1T_1$ followed by $AA_3T_2$.

### 4.5.4 Total sugar, reducing sugar and Titrable acidity of stored sugarcane juice at ambient condition

Table 23 reveals the effect of ascorbic acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition. The maximum and minimum value of total sugar was seen in treatments $AA_2T_3$ (21.3) & $AA_1T_1$, (15.79); $AA_2T_{3,}$

**Table 22 Effect of ascorbic acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition (5°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity |
| **$AA_1T_1$** | 18.75 | 0.214 | 0.51 | 18.69 | 0.318 | 0.60 | 18.63 | 0.679 | 0.66 |
| **$AA_2T_1$** | 21.88 | 0.229 | 0.46 | 21.82 | 0.287 | 0.55 | 21.76 | 0.458 | 0.62 |
| **$AA_3T_1$** | 22.62 | 0.240 | 0.50 | 22.57 | 0.258 | 0.59 | 22.53 | 0.582 | 0.67 |
| **$AA_1T_2$** | 20.49 | 0.204 | 0.38 | 20.43 | 0.339 | 0.47 | 19.39 | 0.384 | 0.54 |
| **$AA_2T_2$** | 20.24 | 0.244 | 0.45 | 20.19 | 0.360 | 0.54 | 20.15 | 0.590 | 0.62 |
| **$AA_3T_2$** | 17.11 | 0.209 | 0.49 | 17.06 | 0.370 | 0.58 | 17.01 | 0.443 | 0.66 |
| **$AA_1T_3$** | 15.63 | 0.205 | 0.27 | 15.58 | 0.321 | 0.36 | 15.47 | 0.452 | 0.45 |
| **$AA_2T_3$** | 19.49 | 0.247 | 0.49 | 19.36 | 0.281 | 0.58 | 19.31 | 0.529 | 0.66 |
| **$AA_3T_3$** | 21.23 | 0.218 | 0.26 | 21.17 | 0.271 | 0.35 | 21.12 | 0.497 | 0.43 |
| **CD@5%** | **1.95** | **0.03** | **0.03** | **2.20** | **0.05** | **0.04** | **1.91** | **0.06** | **0.04** |
| **SEM±** | **0.67** | **0.01** | **0.01** | **0.76** | **0.02** | **0.01** | **0.66** | **0.02** | **0.01** |

**Table 23 Effect of ascorbic acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity sugar of stored sugarcane juice at ambient condition (30°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity | Total sugar | Reducing sugar | Titrable acidity |
| **$AA_1T_1$** | 15.79 | 0.218 | 0.52 | 15.74 | 0.313 | 0.61 | 15.7 | 0.407 | 0.69 |
| **$AA_2T_1$** | 21.23 | 0.224 | 0.41 | 21.18 | 0.295 | 0.50 | 21.15 | 0.608 | 0.58 |
| **$AA_3T_1$** | 18.85 | 0.240 | 0.28 | 18.8 | 0.275 | 0.27 | 18.74 | 0.558 | 0.35 |
| **$AA_1T_2$** | 18.17 | 0.256 | 0.50 | 18.12 | 0.342 | 0.49 | 18.07 | 0.679 | 0.57 |
| **$AA_2T_2$** | 17.36 | 0.204 | 0.30 | 17.32 | 0.345 | 0.39 | 17.28 | 0.479 | 0.47 |
| **$AA_3T_2$** | 16.53 | 0.242 | 0.47 | 16.5 | 0.351 | 0.56 | 16.45 | 0.438 | 0.64 |
| **$AA_1T_3$** | 19.1 | 0.226 | 0.53 | 19.04 | 0.331 | 0.62 | 19 | 0.485 | 0.70 |
| **$AA_2T_3$** | 21.3 | 0.251 | 0.45 | 21.25 | 0.339 | 0.54 | 21.2 | 0.509 | 0.62 |
| **$AA_3T_3$** | 17.53 | 0.227 | 0.51 | 17.49 | 0.281 | 0.60 | 17.44 | 0.443 | 0.68 |
| **CD@5%** | **1.82** | **0.03** | **0.05** | **1.81** | **0.03** | **0.03** | **1.96** | **0.03** | **0.04** |
| **SEM±** | **0.63** | **0.01** | **0.02** | **0.62** | **0.01** | **0.01** | **0.67** | **0.01** | **0.01** |

(21.25) & $AA_1T_1$ (15.74); $AA_2T_3$ (21.2) & $AA_1T_1$ (15.7) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of reducing sugar were found in treatments $AA_2T_2$ (0.204) & $AA_1T_2$ (0.256) for 7 days, $AA_3T_1$ (0.275) & $AA_3T_2$ (0.351) for 14 days and $AA_1T_2$ (0.407) & $AA_2T_1$ (0.608) for 21 days storage of sugarcane juice. The higher and lower values of titrable acidity were in treatment combination, $AA_1T_3$ (0.53) & $AA_3T_1$ (0.28), for 7 days; $AA_1T_3$ (0.62) & $AA_3T_1$ (0.27) for 14 days; $AA_1T_3$ (0.70) & $AA_3T_1$ (0.35) for 21 days respectively.

The statistical analysis all the treatments were found significant. Treatment combination $AA_2T_3$ was at par to $AA_2T_1$ followed by $AA_1T_3$ in total sugar, similarly in case of reducing sugar and titrable acidity treatment $AA_1T_2$ was at par with $AA_2T_3$ and followed by $AA_3T_2$; $AA_1T_3$ was at par with $AA_1T_1$, followed by $AA_3T_3$ respectively, in 7 days storage of period.

On 14 days of storage period, as regards for total sugar, treatment $AA_2T_3$ was at par to $AA_2T_1$ followed by $AA_1T_3$; in $AA_3T_2$ was at par with $AA_2T_2$ & followed by $AA_1T_2$; treatment $AA_3T_2$was at par to $AA_2T_2$ followed by $AA_1T_2$ in titrable acidity respectively.

Finally on 21 days of storage, it was seen that treatment $AA_2T_3$ was at par to $AA_2T_1$ and followed by $AA_1T_3$ for total sugar; for reducing sugar $AA_1T_2$ was at par to $AA_2T_1$ & followed by $AA_3T_1$; in titrable acidity treatment $AA_1T_3$ was at par with $AA_1T_1$ followed by treatment $AA_3T_3$ respectively.

### 4.5.5 Poly phenol oxidease, TSS and phenol content of stored sugarcane juice at refrigerated condition

Table 24 reveals the results of effect of ascorbic acid and pasteurization temperature on poly phenol oxidease, TSS and phenol content of stored sugarcane juice at refrigerated condition. The maximum and minimum value of PPO content was seen at treatments $AA_1T_2$, $AA_1T_3$ (0.034) $AA_3T_3$ (0.029); & $AA_1T_1$ (0.031) $AA_1T_2$, $AA_2T_2$ (0.023); $AA_1T_1$ (0.029) & $AA_1T_2$, $AA_2T_2$, $AA_3T_3$ (0.022) for 7, 14 and 21 days storage respectively. Similarly the lowest and highest values of total soluble solid were found in treatments $AA_3T_2$ (20.4) & $AA_3T_3$ (18.3), for 7 days, $AA_3T_2$ (19.8) & $AA_3T_3$, (18) for 14 days and $AA_3T_2$ (19.5) & $AA_3T_3$ (17) for 21 days of storage. The highest and lowest

**Table 24 Effect of ascorbic acid and pasteurization temperature on poly phenol oxidase (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice at refrigerated condition (5°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | PPO | TSS | Phenol | PPO | TSS | Phenol | PPO | TSS | Phenol |
| **$AA_1T_1$** | 0.032 | 18.5 | 14.65 | 0.031 | 18.3 | 15.05 | 0.029 | 18 | 15.45 |
| **$AA_2T_1$** | 0.031 | 19.7 | 14.76 | 0.030 | 19.5 | 15.16 | 0.028 | 19.3 | 15.56 |
| **$AA_3T_1$** | 0.033 | 18.6 | 14.62 | 0.029 | 18.4 | 15.02 | 0.027 | 18.1 | 15.42 |
| **$AA_1T_2$** | 0.034 | 19.1 | 14.72 | 0.023 | 18.8 | 15.12 | 0.022 | 18.5 | 15.52 |
| **$AA_2T_2$** | 0.031 | 19.7 | 14.74 | 0.023 | 19.5 | 15.14 | 0.022 | 19.2 | 15.54 |
| **$AA_3T_2$** | 0.032 | 20.4 | 14.66 | 0.025 | 19.8 | 15.06 | 0.023 | 19.5 | 15.46 |
| **$AA_1T_3$** | 0.034 | 18.5 | 14.62 | 0.030 | 18.3 | 15.08 | 0.028 | 18 | 15.42 |
| **$AA_2T_3$** | 0.030 | 19.7 | 14.65 | 0.030 | 19.5 | 15.11 | 0.028 | 19.2 | 15.45 |
| **$AA_3T_3$** | 0.029 | 18.3 | 14.74 | 0.025 | 18 | 15.13 | 0.022 | 17 | 15.54 |
| **CD@5%** | **0.03** | **0.05** | **0.61** | **0.03** | **0.58** | **0.83** | **0.06** | **0.75** | **1.03** |
| **SEM±** | **0.01** | **0.02** | **0.21** | **0.01** | **0.20** | **0.29** | **0.03** | **0.26** | **0.35** |

value of phenol content were in treatments, $AA_2T_1$,(14.76) and $AA_3T_{1,}$ $AA_1T_{3,}$ (14.62) for 7 days; $AA_2T_1$ (15.16) & $AA_3T_{1,}$ (15.02) for 14 days; $AA_2T_1$ (15.56) & $AA_3T_{1,}$ $AA_1T_{3,}$ (15.42) for 21 day storage of sugarcane juice.

The finding presented in the table 24 also shows that treatments have got significant effect on poly phenol oxidease, TSS and phenol content of stored sugarcane juice. The treatment $AA_1T_2$ and $AA_3T_2$ was at par to $AA_3T_1$ followed by $AA_3T_2$ in poly phenol oxidease, similarly in total soluble sugar and phenol content treatment $AA_3T_2$ was at par with $AA_2T_1$ and followed by $AA_1T_2$; $AA_2T_1$ was at par with $AA_2T_2$, followed by $AA_1T_2$ respectively, in 7 days storage of period.

On 14 days of storage period for total sugar, treatment combination $AA_1T_1$ was at par to $AA_2T_1$ followed by $AA_3T_1$; in $AA_3T_2$ was at par with $AA_2T_1$ & followed by $AA_1T_2$; treatment $AA_2T_1$ was at par to $AA_2T_2$ followed by $AA_3T_3$ in phenol content.

Finally on 21 days of storage it was seen that treatment $AA_1T_1$ was at par to $AA_2T_1$ and followed by $AA_3T_1$ for poly phenol oxidease; for total soluble sugar $AA_3T_2$ was at par to $AA_2T_1$ & followed by $AA_2T_2$; in phenol content treatment $AA_2T_1$ was at par with $AA_2T_2$ followed by $AA_1T_2$.

### 4.5.6 Poly phenol oxidease, TSS and phenol content of stored sugarcane juice at ambient condition

Table 25 indicates the effect of ascorbic acid and pasteurization temperature on poly phenol oxidease, TSS and phenol content of stored sugarcane juice at ambient condition. The minimum and maximum value of poly phenol oxidease activity was seen in treatments $AA_1T_2$, $AA_1T_3$ (0.054) & $AA_3T_3$ (0.049); $AA_1T_{1,}$ $AA_1T_{2,}$ $AA_2T_2$ (0.043) & $AA_1T_3$ (0.030); $AA_2T_1$ (0.031) & $AA_3T_3$ (0.026) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of total soluble solid were found in treatments $AA_3T_2$ (20.4) & $AA_3T_3$ (18) for 7 days, $AA_3T_2$ (20.1) & $AA_3T_3$ (17.7) for 14 days and $AA_2T_1$ (19.2) & $AA_3T_3$ (17.3) for 21 days. The phenol content, higher and lower values were as follows: $AA_2T_1$ (14.36) & $AA_3T_{1,}$ $AA_1T_3$ (14.22) and for 7 days; $AA_2T_1$ (14.76), $AA_3T_{1,}$ $AA_3T_{1,}$ (14.62) for 14 days; $AA_2T_1$ (15.16) & $AA_3T_1$ ,$AA_1T_{3,}$ (15.02) for 21 days respectively.

**Table 25 Effect of ascorbic acid and pasteurization temperature on poly phenol oxidase (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice at ambient condition (30°C)**

| Treatment | Storage Period | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 days | | | 14 days | | | 21 days | | |
| | PPO | TSS | Phenol | PPO | TSS | Phenol | PPO | TSS | Phenol |
| **$AA_1T_1$** | 0.052 | 18.3 | 14.25 | 0.043 | 18.1 | 14.65 | 0.030 | 17.8 | 15.05 |
| **$AA_2T_1$** | 0.051 | 19.8 | 14.36 | 0.042 | 19.6 | 14.76 | 0.031 | 19.2 | 15.16 |
| **$AA_3T_1$** | 0.053 | 18.4 | 14.22 | 0.040 | 18.2 | 14.62 | 0.029 | 17.9 | 15.02 |
| **$AA_1T_2$** | 0.054 | 19.1 | 14.32 | 0.043 | 18.9 | 14.72 | 0.029 | 18.5 | 15.12 |
| **$AA_2T_2$** | 0.051 | 19.7 | 14.34 | 0.043 | 19.5 | 14.74 | 0.030 | 19.1 | 15.14 |
| **$AA_3T_2$** | 0.052 | 20.4 | 14.26 | 0.042 | 20.1 | 14.66 | 0.028 | 19.7 | 15.06 |
| **$AA_1T_3$** | 0.054 | 18.3 | 14.22 | 0.030 | 18.1 | 14.62 | 0.029 | 17.7 | 15.02 |
| **$AA_2T_3$** | 0.050 | 19.5 | 14.25 | 0.035 | 19.3 | 14.65 | 0.029 | 19 | 15.05 |
| **$AA_3T_3$** | 0.049 | 18 | 14.34 | 0.031 | 17.7 | 14.74 | 0.026 | 17.3 | 15.14 |
| **CD@5%** | **0.08** | **0.72** | **0.62** | **0.02** | **0.99** | **0.50** | **0.05** | **1.05** | **0.65** |
| **SEM±** | **0.03** | **0.25** | **0.21** | **0.01** | **0.34** | **0.17** | **0.02** | **0.36** | **0.22** |

Table 25 shows that treatment $AA_1T_2$ was at par to $AA_3T_1$ followed by $AA_1T_1$ in poly phenol oxidease, similarly in total soluble solid and phenol content treatment $AA_3T_2$ was at par with $AA_2T_1$ and followed by $AA_2T_2$; $AA_2T_1$ was at par with $AA_2T_2$, followed by $AAT_2$ respectively, in 7 days storage of period.

On 14 days of storage period for poly phenol oxidease, treatment $AA_1T_1$ was at par to $AA_2T_1$ followed by $AA_3T_2$; in $AA_3T_2$ was at par with $AA_2T_1$ & followed by $AA_2T_2$; treatment $AA_2T_1$ was at par to $AA_2T_2$ followed by $AA_1T_2$ in phenol content.

Finally on 21 days of storage it was seen that treatment $AA_2T_1$ was at par to $AA_1T_1$ and followed by $AA_3T_1$ for poly phenol oxidease; for total soluble solid treatment $AA_3T_2$ was at par to $AA_2T_1$ & followed by $AA_2T_2$; In case of phenol content, treatment combination $AA_2T_1$ was at par with $AA_2T_2$ followed by $AA_3T_1$.

### 4.6 Effect of Citric acid and pasteurization temperature on total plate count of stored sugar cane juice at ambient and refrigerated condition.

Table 26 indicates the effect of citric acid and pasteurization temperature on total plate count of stored sugarcane juice at ambient and refrigerated condition. The minimum and maximum value of total plate count was seen in treatments $CA_3T_3$ (1.66) & $CA_1T_1$ (1.86); $CA_3T_3$ (1.76) & $CA_1T_1$ (1.91); $CA_3T_3$ (1.86) & $CA_1T_1$ (2.06) for 7, 14 and 21 days respectively in refrigerated condition. Similarly the lowest and highest values of total plate count in ambient condition for 7, 14 and 21 days were recorded in treatments $CA_3T_3$ (1.79) & $CA_1T_1$ (1.96); $CA_3T_3$ (1.89) & $CA_1T_1$ (2.06); $CA_3T_3$ (1.99) & $CA_1T_1$ (2.16) respectively.

Table 26 shows that treatment $CA_1T_1$ at par to $CA_2T_1$ followed by $CA_3T_1$ in refrigerated condition, similarly, in ambient condition treatment $CA_1T_1$ was at par to $CA_2T_1$ followed by $CA_3T_1$ on 7 days storage of period.

On 14 days of storage period in refrigerated condition, treatment $CA_1T_1$ was at par to $CA_2T_1$ followed by $CA_3T_1$ and in same manner in ambient condition treatment $CA_1T_1$ was at par with $CA_2T_1$ followed by $CA_3T_1$.

**Table 26 Effect of citric acid and pasteurization temperature on total plate count of stored sugarcane juice at refrigerated and ambient condition**

| Treatment | Storage Period | | | | | |
|---|---|---|---|---|---|---|
| | (5°C) | | | (30°C) | | |
| | 7 days | 14 days | 21 days | 7 days | 14 days | 21 days |
| $CA_1T_1$ | 1.86 | 1.96 | 2.06 | 1.96 | 2.06 | 2.16 |
| $CA_2T_1$ | 1.82 | 1.92 | 2.02 | 1.92 | 2.02 | 2.12 |
| $CA_3T_1$ | 1.80 | 1.9 | 2 | 1.9 | 2 | 2.1 |
| $CA_1T_2$ | 1.78 | 1.88 | 1.98 | 1.88 | 1.98 | 2.08 |
| $CA_2T_2$ | 1.75 | 1.85 | 1.95 | 1.85 | 1.95 | 2.05 |
| $CA_3T_2$ | 1.72 | 1.82 | 1.92 | 1.82 | 1.92 | 2.02 |
| $CA_1T_3$ | 1.71 | 1.81 | 1.91 | 1.86 | 1.96 | 2.06 |
| $CA_2T_3$ | 1.69 | 1.79 | 1.89 | 1.82 | 1.92 | 2.02 |
| $CA_3T_3$ | 1.66 | 1.76 | 1.86 | 1.79 | 1.89 | 1.99 |
| **CD@5%** | **0.92** | **0.87** | **0.28** | **0.97** | **1.04** | **0.95** |
| **SEM±** | **0.28** | **0.27** | **0.41** | **0.30** | **0.32** | **0.29** |

Finally on 21 days of storage in refrigerated condition, it was seen that treatment $CA_1T_1$ was at par to $CA_2T_1$ followed by $CA_3T_1$. Similarly, in ambient condition treatment $CA_1T_1$ was at par to $CA_2T_1$ followed by $CA_3T_1$ for total plate count.

### 4.7 Effect of potassium meta bisulphite and pasteurization temperature on total plate count of stored sugar cane juice at ambient and refrigerated condition.

Table 27 indicates the effect of potassium meta bisulphite and pasteurization temperature on total plate count of stored sugarcane juice at ambient and refrigerated condition. The minimum and maximum value of total plate count was seen in treatments $KMS_3T_1$ (1.70) & $KMS_1T_1$ (1.78); $KMS_3T_1$ (1.80) & $KMS_1T_1$ (1.88); $KMS_3T_1$ (1.90) & $KMS_1T_1$ (1.98) for 7, 14 and 21 days respectively in refrigerated condition. Similarly the lowest and highest values of total plate count in ambient condition for 7, 14 and 21 days were recorded in treatments $KMS_2T_1$, $KMS_3T_3$ (14.15) & $KMS_2T_2$, $KMS_2T_3$ (14.45); $KMS_2T_1$, $KMS_3T_3$ (14.55) & $KMS_2T_2$, $KMS_2T_3$ (14.85); $KMS_3T_2$ (14.94) & $KMS_2T_2$, $KMS_2T_3$ (15.25) respectively.

Table 27 shows that treatment $KMS_1T_1$ at par to $KMS_2T_1$ followed by $KMS_3T_1$ in refrigerated condition, similarly, in ambient condition treatment $KMS_2T_2$ was at par to $KMS_2T_3$, $KMS_3T_1$ followed by $KMS_1T_3$ on 7 days storage of period.

On 14 days of storage period in refrigerated condition, treatment $KMS_1T_1$ was at par to $KMS_2T_1$ followed by $KMS_2T_2$ and in same manner in ambient condition treatment $KMS_2T_2$ & $KMS_2T_3$ was at par with $KMS_3T_1$, $KMS_1T_3$ followed by $KMS_1T_2$.

Finally on 21 days of storage in refrigerated condition, it was seen that treatment $KMS_1T_1$ was at par to $KMS_2T_1$ followed by $KMS_2T_2$. Similarly, in ambient condition treatment $KMS_2T_2$, $KMS_2T_3$ was at par to $KMS_3T_1$ & $KMS_1T_3$ followed by $KMS_1T_2$ for total plate count.

**Table 27 Effect of Potassium metabisuphite and pasteurization temperature on total plate count of stored sugarcane juice at refrigerated and ambient condition**

| Treatment | Storage Period | | | | | |
|---|---|---|---|---|---|---|
| | (5°C) | | | (30°C) | | |
| | 7 days | 14 days | 21 days | 7 days | 14 days | 21 days |
| **$KMS_1T_1$** | 1.78 | 1.88 | 1.98 | 2.10 | 2.12 | 2.15 |
| **$KMS_2T_1$** | 1.76 | 1.86 | 1.96 | 2.07 | 2.1 | 2.1 |
| **$KMS_3T_1$** | 1.70 | 1.8 | 1.9 | 2.02 | 2.04 | 2.07 |
| **$KMS_1T_2$** | 1.76 | 1.86 | 1.96 | 1.97 | 1.99 | 2.01 |
| **$KMS_2T_2$** | 1.75 | 1.85 | 1.95 | 1.93 | 1.96 | 1.99 |
| **$KMS_3T_2$** | 1.73 | 1.83 | 1.93 | 1.88 | 1.9 | 1.93 |
| **$KMS_1T_3$** | 1.73 | 1.83 | 1.93 | 1.85 | 1.88 | 1.89 |
| **$KMS_2T_3$** | 1.73 | 1.83 | 1.93 | 1.80 | 1.82 | 1.82 |
| **$KMS_3T_3$** | 1.72 | 1.82 | 1.92 | 1.76 | 1.78 | 1.8 |
| **CD@5%** | **0.60** | **0.76** | **0.71** | **0.81** | **0.55** | **0.92** |
| **SEM±** | **0.19** | **0.24** | **0.22** | **0.25** | **0.17** | **0.28** |

## 4.8 Effect of potassium sorbate and pasteurization temperature on total plate count of stored sugar cane juice at ambient and refrigerated condition.

Table 28 indicates the effect of potassium sorbate and pasteurization temperature on total plate count of stored sugarcane juice at ambient and refrigerated condition. In refrigerated condition the minimum and maximum value of total plate count was seen in treatments $PS_3T_1$ (1.60) & $PS_1T_1$ (1.68); $PS_3T_1$ (1.70) & $PS_1T_1$ (1.88); $PS_3T_1$ (1.80) & $PS_1T_1$ (1.88) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of total plate count in ambient condition for 7, 14 and 21 days were recorded in treatments $PS_2T_1$, $PS_3T_3$ (13.15) & $PS_2T_2$, $PS_2T_3$ (13.45); $KMS_2T_1$, $PS_3T_3$ (13.55) & $PS_2T_2$, $PS_2T_3$ (13.85); $PS_3T_2$ (13.94) & $PS_2T_2$, $PS_2T_3$ (14.25) respectively.

Table 27 shows that treatment $PS_1T_1$ at par to $PS_2T_1$ followed by $PS_3T_1$ in refrigerated condition, similarly, in ambient condition treatment $PS_2T_2$ was at par to $PS_2T_3$, $PS_3T_1$ followed by $PS_1T_3$ on 7 days storage of period.

On 14 days of storage period in refrigerated condition, treatment $PS_1T_1$ was at par to $PS_2T_1$ followed by $PS_2T_2$ and in same manner in ambient condition treatment $PS_2T_2$ & $PS_2T_3$ was at par with $PS_3T_1$, $PS_1T_3$ followed by $PS_1T_2$.

Finally on 21 days of storage in refrigerated condition, it was seen that treatment $PS_1T_1$ was at par to $PS_2T_1$ followed by $PS_2T_2$. Similarly, in ambient condition treatment $PS_2T_2$, $PS_2T_3$ was at par to $PS_3T_1$ & $PS_1T_3$ followed by $PS_1T_2$ for total plate count.

## 4.9 Effect of ascorbic acid and pasteurization temperature on total plate count of stored sugarcane juice at ambient and refrigerated condition

Table 29 indicates the effect of potassium sorbate and pasteurization temperature on total plate count of stored sugarcane juice at ambient and refrigerated condition. In refrigerated condition the minimum and maximum value of total plate count was seen in treatments $PS_3T_1$ (1.60) & $PS_1T_1$ (1.68); $PS_3T_1$ (1.70) & $PS_1T_1$ (1.88); $PS_3T_1$ (1.80) & $PS_1T_1$ (1.88) for 7, 14 and 21 days respectively. Similarly the lowest and highest values of total plate count

**Table 28 Effect of Potassium sorbate and pasteurization temperature on total plate count of stored sugarcane juice at refrigerated and ambient condition**

| Treatment | Storage Period | | | | | |
|---|---|---|---|---|---|---|
| | (5°C) | | | (30°C) | | |
| | 7 days | 14 days | 21 days | 7 days | 14 days | 21 days |
| $PS_1T_1$ | 1.76 | 1.83 | 1.9 | 1.88 | 1.98 | 2.08 |
| $PS_2T_1$ | 1.76 | 1.88 | 1.96 | 1.89 | 1.97 | 2.04 |
| $PS_3T_1$ | 1.71 | 1.82 | 1.91 | 1.87 | 1.97 | 2.06 |
| $PS_1T_2$ | 1.78 | 1.85 | 1.95 | 1.76 | 1.89 | 1.98 |
| $PS_2T_2$ | 1.75 | 1.85 | 1.92 | 1.78 | 1.89 | 1.97 |
| $PS_3T_2$ | 1.75 | 1.82 | 1.93 | 1.89 | 1.98 | 2.14 |
| $PS_1T_3$ | 1.69 | 1.75 | 1.83 | 1.98 | 2.12 | 2.19 |
| $PS_2T_3$ | 1.71 | 1.86 | 1.91 | 1.67 | 1.79 | 1.94 |
| $PS_3T_3$ | 1.75 | 1.80 | 1.89 | 1.76 | 1.89 | 1.97 |
| **CD@5%** | **0.58** | **0.99** | **0.77** | **0.50** | **0.61** | **0.56** |
| **SEM±** | **0.18** | **0.30** | **0.24** | **0.26** | **0.19** | **0.17** |

**Table 29 Effect of Ascorbic acid and pasteurization temperature on total plate count of stored sugarcane juice at refrigerated and ambient condition**

| Treatment | Storage Period | | | | | |
|---|---|---|---|---|---|---|
| | (5°C) | | | (30°C) | | |
| | 7 days | 14 days | 21 days | 7 days | 14 days | 21 days |
| $AA_1T_1$ | 1.72 | 1.75 | 1.78 | 1.73 | 1.76 | 1.80 |
| $AA_2T_1$ | 1.75 | 1.78 | 1.80 | 1.76 | 1.78 | 1.81 |
| $AA_3T_1$ | 1.78 | 1.82 | 1.83 | 1.79 | 1.84 | 1.85 |
| $AA_1T_2$ | 1.79 | 1.81 | 1.84 | 1.82 | 1.86 | 1.88 |
| $AA_2T_2$ | 1.82 | 1.84 | 1.85 | 1.83 | 1.86 | 1.87 |
| $AA_3T_2$ | 1.85 | 1.87 | 1.89 | 1.97 | 2.01 | 2.2 |
| $AA_1T_3$ | 1.88 | 1.93 | 1.94 | 1.94 | 1.99 | 2. |
| $AA_2T_3$ | 1.98 | 2.01 | 2.2 | 1.98 | 2.07 | 2.12 |
| $AA_3T_3$ | 1.99 | 2.05 | 2.3 | 1.94 | 2.2 | 2.4 |
| **CD@5%** | **0.63** | **2.82** | **0.77** | **1.61** | **0.77** | **2.81** |
| **SEM±** | **0.19** | **0.87** | **0.24** | **0.80** | **0.24** | **0.86** |

in ambient condition for 7, 14 and 21 days were recorded in treatments $PS_2T_1$, $PS_3T_3$ (13.15) & $PS_2T_2$, $PS_2T_3$ (13.45); $KMS_2T_1$, $PS_3T_3$ (13.55) & $PS_2T_2$, $PS_2T_3$ (13.85); $PS_3T_2$ (13.94) & $PS_2T_2$, $PS_2T_3$ (14.25) respectively.

Table 27 shows that treatment $PS_1T_1$ at par to $PS_2T_1$ followed by $PS_3T_1$ in refrigerated condition, similarly in ambient condition treatment $PS_2T_2$ was at par to $PS_2T_3$, $PS_3T_1$ followed by $PS_1T_3$ on 7 days storage of period.

On 14 days of storage period in refrigerated condition, treatment $PS_1T_1$ was at par to $PS_2T_1$ followed by $PS_2T_2$ and in same manner in ambient condition treatment $PS_2T_2$ & $PS_2T_3$ was at par with $PS_3T_1$, $PS_1T_3$ followed by $PS_1T_2$.

Finally on 21 days of storage in refrigerated condition, it was seen that treatment $PS_1T_1$ was at par to $PS_2T_1$ followed by $PS_2T_2$. Similarly, in ambient condition treatment $PS_2T_2$, $PS_2T_3$ was at par to $PS_3T_1$ & $PS_1T_3$ followed by $PS_1T_2$ for total plate count.

### 4.10 Effect of Citric acid and pasteurization temperature on Overall acceptability sensory score of stored sugarcane juice

Table 30 indicates the results of effect of citric acid and pasteurization temperature on overall acceptability sensory score of stored sugarcane juice at ambient and refrigerated condition. It varies from 8.46 to 8.86,8.35 to8.78 and 8.29 to 8.67 at 7,14 and 21 days store sugarcane juice under refrigerated conditions. The mean value of sensory score at ambient condition of storage were found to be 8.35 to 8.74, 8.26 to8.6 and 8.17 to 8.45 at 7,14 and 21 days store sugarcane juice The also reveals that stored sugarcane juice under both conditions of storage have received the sensory score above 8.0 which comes under category of liked very much.

### 4.11 Effect of potassium metabisulfite and pasteurization temperature on Overall acceptability sensory score of stored sugarcane juice

Table 31 shows the results of effect of potassium metabisulfite and pasteurization temperature on overall acceptability sensory score of stored sugarcane juice at ambient and refrigerated condition. It varies from 8.85 to 8.90, 8.61 to 8.75 and 8.34 to 55 at 7, 14 and 21 days store sugarcane juice

**Table 30 Effect of citric acid and pasteurization temperature on overall acceptability (Colour, Taste and Flavour) sensory score of stored sugarcane juice at refrigerated and ambient condition**

| Treatment | Storage Period | | | | | |
|---|---|---|---|---|---|---|
| | (5°C) | | | (30°C) | | |
| | 7 days | 14 days | 21 days | 7 days | 14 days | 21 days |
| $CA_1T_1$ | 8.46 | 8.35 | 8.29 | 8.35 | 8.26 | 8.18 |
| $CA_2T_1$ | 8.86 | 8.76 | 8.65 | 8.56 | 8.45 | 8.34 |
| $CA_3T_1$ | 8.67 | 8.56 | 8.48 | 8.38 | 8.28 | 8.17 |
| $CA_1T_2$ | 8.68 | 8.54 | 8.45 | 8.49 | 8.37 | 8.26 |
| $CA_2T_2$ | 8.85 | 8.78 | 8.67 | 8.58 | 8.46 | 8.35 |
| $CA_3T_2$ | 8.76 | 8.67 | 8.56 | 8.64 | 8.56 | 8.45 |
| $CA_1T_3$ | 8.67 | 8.56 | 8.45 | 8.74 | 8.62 | 8.45 |
| $CA_2T_3$ | 8.56 | 8.46 | 8.35 | 8.38 | 8.29 | 8.23 |
| $CA_3T_3$ | 8.65 | 8.56 | 8.45 | 8.49 | 8.34 | 8.26 |

**Table 31 Effect of potassium metabisulfite and pasteurization temperature on overall acceptability (Colour, Taste and Flavour) sensory score of stored sugarcane juice at refrigerated and ambient condition**

| Treatment | Storage Period | | | | | |
|---|---|---|---|---|---|---|
| | (5°C) | | | (30°C) | | |
| | 7 days | 14 days | 21 days | 7 days | 14 days | 21 days |
| $KMS_1T_1$ | 8.98 | 8.71 | 8.55 | 8.84 | 8.57 | 8.25 |
| $KMS_2T_1$ | 8.95 | 8.72 | 8.53 | 8.75 | 8.56 | 8.39 |
| $KMS_3T_1$ | 8.94 | 8.74 | 8.53 | 8.75 | 8.64 | 8.28 |
| $KMS_1T_2$ | 8.93 | 8.69 | 8.34 | 8.53 | 8.26 | 8.49 |
| $KMS_2T_2$ | 8.97 | 8.75 | 8.51 | 8.63 | 8.34 | 8.57 |
| $KMS_3T_2$ | 8.85 | 8.61 | 8.45 | 8.73 | 8.52 | 8.38 |
| $KMS_1T_3$ | 8.96 | 8.74 | 8.53 | 8.85 | 8.73 | 8.40 |
| $KMS_2T_3$ | 8.94 | 8.68 | 8.43 | 8.75 | 8.62 | 8.58 |
| $KMS_3T_3$ | 8.93 | 8.74 | 8.52 | 8.73 | 8.61 | 8.56 |

under refrigerated conditions. The mean value of sensory score at ambient condition of storage were found to be 8.53 to 8.85, 8.34 to 8.73 and 8.25 to 8.58 at 7, 14 and 21 days stored sugarcane juice. The table also reveals that stored sugarcane juice under both conditions of storage have again received the sensory score above 8.0 which comes under category of liked very much.

### 4.12 Effect of potassium sorbate and pasteurization temperature on Overall acceptability sensory score of stored sugarcane juice

The effect of potassium sorbate and pasteurization temperature on overall acceptability sensory score of stored sugarcane juice at ambient and refrigerated condition is presented in table 32. It varies from 8.57 to 8.84, 8.34 to 8.71 and 8.20 to 8.52 at 7, 14 and 21 days store sugarcane juice under refrigerated conditions. The mean value of sensory score at ambient condition of storage were found to be 8.54 to 8.76, 8.43 to 8.67 and 8.34 to 8.57 at 7, 14 and 21 days stored sugarcane juice. The table also reveals that stored sugarcane juice under both conditions of storage have again received the sensory score above 8.0 which comes under category of liked very much.

### 4.13 **Effect of ascorbic acid and pasteurization temperature on Overall acceptability sensory score of stored sugarcane juice**

The effect of ascorbic acid and pasteurization temperature on overall acceptability sensory score of stored sugarcane juice at ambient and refrigerated condition is presented in table 33. It varies from 8.68 to 8.94, 8.67 to 8.85 and 8.46 to 8.76 at 7, 14 and 21 days store sugarcane juice under refrigerated conditions. The mean value of sensory score at ambient condition of storage were found to be 8.36 to 8.65, 8.25 to 8.57 and 8.16 to 8.48 at 7, 14 and 21 days stored sugarcane juice. The table also reveals that stored sugarcane juice under both conditions of storage have again received the sensory score above 8.0 which comes under category of liked very much.

The finding presented indicates the possibilities of preservation of sugarcane juice by using chemical preservatives. The justification of findings with the results of other research are given in next chapter.

**Table 32 Effect of potassium sorbate and pasteurization temperature on overall acceptability (Colour, Taste and Flavour) sensory score of stored sugarcane juice at refrigerated and ambient condition**

| Treatment | Storage Period | | | | | |
|---|---|---|---|---|---|---|
| | (5°C) | | | (30°C) | | |
| | 7 days | 14 days | 21 days | 7 days | 14 days | 21 days |
| $PS_1T_1$ | 8.65 | 8.43 | 8.24 | 8.65 | 8.50 | 8.45 |
| $PS_2T_1$ | 8.57 | 8.34 | 8.20 | 8.54 | 8.43 | 8.37 |
| $PS_3T_1$ | 8.57 | 8.37 | 8.20 | 8.76 | 8.65 | 8.57 |
| $PS_1T_2$ | 8.58 | 8.71 | 8.52 | 8.74 | 8.65 | 8.55 |
| $PS_2T_2$ | 8.69 | 8.41 | 8.20 | 8.64 | 8.56 | 8.45 |
| $PS_3T_2$ | 8.84 | 8.65 | 8.43 | 8.73 | 8.46 | 8.34 |
| $PS_1T_3$ | 8.75 | 8.54 | 8.35 | 8.64 | 8.56 | 8.45 |
| $PS_2T_3$ | 8.74 | 8.51 | 8.37 | 8.64 | 8.57 | 8.45 |
| $PS_3T_3$ | 8.82 | 8.64 | 8.40 | 8.75 | 8.67 | 8.56 |

**Table 33 Effect of ascorbic acid and pasteurization temperature on overall acceptability (Colour, Taste and Flavour) sensory score of stored sugarcane juice at refrigerated and ambient condition**

| Treatment | Storage Period | | | | | |
|---|---|---|---|---|---|---|
| | (5°C) | | | (30°C) | | |
| | 7 days | 14 days | 21 days | 7 days | 14 days | 21 days |
| $AA_1T_1$ | 8.78 | 8.67 | 8.56 | 8.45 | 8.35 | 8.23 |
| $AA_2T_1$ | 8.87 | 8.79 | 8.65 | 8.36 | 8.25 | 8.16 |
| $AA_3T_1$ | 8.79 | 8.68 | 8.56 | 8.36 | 8.26 | 8.18 |
| $AA_1T_2$ | 8.68 | 8.57 | 8.46 | 8.47 | 8.36 | 8.25 |
| $AA_2T_2$ | 8.75 | 8.69 | 8.57 | 8.58 | 8.49 | 8.35 |
| $AA_3T_2$ | 8.94 | 8.85 | 8.76 | 8.65 | 8.57 | 8.48 |
| $AA_1T_3$ | 8.73 | 8.68 | 8.76 | 8.54 | 8.47 | 8.36 |
| $AA_2T_3$ | 8.85 | 8.67 | 8.57 | 8.47 | 8.36 | 8.27 |
| $AA_3T_3$ | 8.85 | 8.76 | 8.68 | 8.53 | 8.45 | 8.39 |

## Summary, conclusion, Suggestion and Further Work

## Summary

Sugarcane is one of the most important agro-industrial crops in our country. The total production of sugarcane in India during the year 2017-18 was 330 million tones. Uttar Pradesh and Maharashtra are the two largest sugarcane producing states in the country, accounting for more than 80 percent of the annual crop production (Anonymous 2011). India stands second among other sugarcane growing countries, contributing nearly 20.40% area and 18.60% production. Fresh Sugarcane juice is popular beverage in Southeast Asia, South Asia, Latin America, and also in other countries where sugarcane is grown commercially. Sugarcane juice provide vitamins A, C, B1, B2, B3, B5, B6 and iron with a high concentration of phytonutrients (including chlorophyll), antioxidants, proteins, soluble fibre and numerous other health supportive compounds (Karthikeyan and Samipillai, 2010). As sugarcane juice is rich in sugar, it starts fermenting immediately after extraction and also turns brown due to poly phenol oxidease activity (Qudsieh *et al* 2002). Microbial fermentation of the juice turns its taste to sour within few hours of extraction (Yusof *et al* 2000). All these negative changes limit the processing and marketing of sugarcane juice (Eggleston 2002). Development of a preservation method, which can control microbial growth in raw sugarcane juice and maintain its freshness, is a challenging problem for ensuring its wider distribution and availability. In this context the present investigation entitle “studies of shelf life extension of sugarcane juice’’ has been planned. The find are summarized as under

The effect of levels of citric acid and pasteurization temperature shows significant effect of treatment combination on moisture, carbohydrate ash, total sugar, reducing sugar, titrable acidity, poly phenol oxidease (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice under refrigerated and ambient condition.

The effect of levels of potassium metabisulfite and pasteurization temperature shows significant effect of treatment combination on moisture, carbohydrate ash, total sugar, reducing sugar, titrable acidity, poly phenol oxidease (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice under refrigerated and ambient condition. .

The effect of levels of potassium sorbate and pasteurization temperature exhibited significant effect of treatment combination on moisture, carbohydrate ash, total sugar, reducing sugar, titrable acidity, poly phenol oxidease (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice under refrigerated and ambient condition. .

The effect of levels of ascorbic acid and pasteurization temperature shows significant effect of treatment combination on moisture, carbohydrate ash, total sugar, reducing sugar, titrable acidity, poly phenol oxidease (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice under refrigerated and ambient condition.

The levels of citric acid, potassium metabisulphite, potassium sorbate, ascorbic acid and pasteurization temperature exhibits significant effect on total plate count at refrigerated and ambient condition.

The effect of citric acid and pasteurization temperature on overall acceptability sensory score of stored sugarcane juice at ambient and refrigerated condition varies from 8.46 to 8.86,8.35 to8.78, 8.29 to 8.67 and 8.35 to 8.74, 8.26 to8.6 and 8.17 to 8.45 at 7, 14 and 21 days stored sugarcane juice under refrigerated and ambient condition respectively.

The effect of levels of potassium metabisulfite and pasteurization on overall acceptability sensory score of stored sugarcane juice at ambient and refrigerated condition varies from 8.85 to 8.90, 8.61 to 8.75 and 8.34 to 55 and 8.53 to 8.85, 8.34 to 8.73, 8.25 to 8.58 at 7, 14 and 21 days storage sugarcane juice.

The results of effect of potassium sorbate and pasteurization temperature on varies from 8.57 to 8.84, 8.34 to 8.71 and 8.20 to 8.52 at 7, 14 and 21 days store sugarcane juice under refrigerated conditions. While the mean value of sensory score at ambient condition of storage were found to be 8.54 to 8.76, 8.43 to 8.67 and 8.34 to 8.57 at 7,14 and 21 days stored sugarcane juice

The effect of ascorbic acid and pasteurization temperature on overall acceptability sensory score of stored sugarcane juice at ambient and refrigerated condition varies from 8.68 to 8.94, 8.67 to 8.85, 8.46 to 8.76 and 8.36 to 8.65, 8.25 to 8.57, 8.16 to 8.48 at 7, 14 and 21 days storage of sugarcane juice respectively.

**Conclusion and Suggestion for Further Work**

**Conclusion**

In a nut shell it is reduced from the findings of present investigation and their justification that different treatment combination of preservatives with pasteurization temperature can be successfully utilized for development of preserved bottled sugarcane juice without sacrificing the quality of product. The shelf life of sugarcane juice can be enhanced for 14 days by using treatment combination potassium metabisulfite and pasteurization temperature of at concentration of 0.15ppm and 70 $^{0}$C. respectively. The preservation technology has got great potential for value addition in food processing industries. The standardized optimum condition of can be successfully translated at commercial scale for domestic and commercial application.

## Suggestion for Further Work

1. Further research work is needed to explore use other preservative for long term storage of sugarcane juice.
2. Research work is needed to study the effect of preservatives and processing technique on quality of product and health aspects of consumer
3. Further research work is required to study on ultra filtration of sugarcane juice for long term storage.

# LIST OF FIGURES

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# CURRICULUM VITAE

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**Scientific interests**

a. Research Works on Product development.
b. Canning of fruits and vegetables.

For the partial fulfilment of the master's degree programme he was allotted a research work on "**Studies on Shelf Life Extension of Sugarcane Juice**" which was successfully conducted by him and being submitted in the form of the thesis.

# ABSTRACT

The present investigations entitled "**Study on shelf life extension of sugarcane juice**". Sugarcane juice was subjected to evaluation with treatment (Citric acid 0.2, 0.4, 0.6, potassium meta-bisulphite 0.15, 0.20, 0.25 ppm, potassium sorbate 0.25, 0.50, 0.75 %, ascorbic acid 0.2, 0.4, 0.6 %, pasteurization with 60, 70, 80 $^{0}$C and storage at 5 and 30 $^{0}$C temperature). The total number of treatments were subjected to various chemical evaluation (Moisture, carbohydrates, ash, total sugar, reducing sugar, TSS, titrable acidity, polyphenol oxidase activity, phenol content and microbial count) as well as sensory evaluation with the storage study for 7, 14 and 21 days in glass bottle. The best treatment combination was 70 $^{0}$C pasteurization temperature, 0.15 ppm potassium metabisulphate, storage time 14 days at 5 $^{0}$C temperature. The microbial count was minimum in the 14 days stored at 5 $^{0}$C with the treatment combination of 0.15 % postassium metabisulphite and 70 $^{0}$C pasteurization temperature. The stored sugarcane juice was subjected to sensory evaluation and the highest sensory score was 14 days stored sugarcane juice at 5 $^{0}$C temperature.


**(Shekhar Gautam Dohre)** **(Dr. S. S. Shukla)**

**Signature of the student** **Signature of the Advisor**

# LIST OF TABLES

# DISCUSSION

Extension of shelf life of sugarcane juice is an area of current research interest because of unavailability of viable technology of sugarcane juice processing and preservation at domestic and commercial level. Very meager information is available on the same; therefore the proposed research work has been planned. This chapter deals with the justification of the findings obtained in the experiments related to studies on effect of different chemical preservatives on chemical composition, microbial counts and sensory quality attributes of sugarcane juice for 7, 14 and 21 days storage period. The findings obtained in various experiments of study have been explained with the help of figures 2 to 33 and with the reported values of various researchers and discussed as under:

## 5.1 Effect of citric acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice.

The finding presented through figure 2 to 3 exhibits that after 7 days of storage period of sugarcane juice under refrigerated condition, the moisture, carbohydrate and ash varied from 75.40 to 80.88%; 13.68 to 16.20%; 0.2 to 0.6 % respectively. On 14 days of storage they varied from 76.75 to 82.81%; 13.73 to 16.27%; 0.2 to 0.6% respectively. Similarly upon 21 days of storage period it varied from 76.4 to 80.79%; 13.82 to 17.23%; 0.2 to 0.6% respectively.

Under ambient condition of storage of sugarcane juice the moisture, carbohydrate and ash content showed variation from 76.30 to 81.70%; 13.73 to 15.76%; 0.2 to 0.4% (7 days) 76.77 to 84.35%; 13.64 to 17.16%; 0.2 to 0.4% (14 days) and 76.10 to 81.40%; 13.78 to 18.16%; 0.2 to 0.4% (21 days) of storage period respectively. The similar findings of moisture, carbohydrate and ash content were also reported by Chouhan (2002).

## 5.2. Effect of citric acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice.

The finding presented in figure 4 to 5 indicates that on 7 days of storage period of sugarcane juice the effect of citric acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity content varied from 16.78 to 19.91%; 0.204 to 0.264%; 0.26 to 0.53% respectively. Similarly for 14 days of storage the same varied from 16.71 to 19.86%; 0.258 to 0.364%; 0.35 to 0.62% respectively. During 21 days of storage period the values of total sugar, reducing sugar and titrable acidity were found to be 16.65 to 19.81%; 0.399 to 0.679%; 0.42 to 0.70% respectively. The titrable acidity of sugarcane juice increased during storage. This might be due to the fact that acetic and lactic acid production took place during storage.

A cursory view of findings informs that at ambient condition during 7 days of storage period of sugarcane juice the effect of citric acid and pasteurization temperature on the total sugar, reducing sugar and titrable acidity, indicates variability of 17.86 to 22.62%; 0.204 to 0.271%; 0.28 to 0.53% respectively. Similarly on 14 days of storage the same varied from 17.81 to 22.56%; 0.273 to 0.370%; 0.37 to 0.62% respectively. Upon 21 days of storage period the same varied from 17.77 to 19.81%; 0.424 to 0.679%; 0.45 to 0.70 %respectively. It may be due to total sugars content was decreased during storage. This could be due to action of microorganism present in the juice, converted the total sugars into reducing sugars (glucose and fructose). Sugarcane juice stored at $30^0$ C recorded higher acidity range compared to those stored at $5^0$ C similar findings were also reported by Chauhan et al. (1997) and Yusuf et al. (2002).

There was an increase in reducing sugars during storage. This might be due to the fact that the hydrolysis of non-reducing sugars (sucrose) into reducing sugars (glucose and fructose) by the action of microorganism. The results are in agreement with findings of Singh et al. (2002).

## 5.3. Effect of citric acid and pasteurization temperature on poly phenol oxidease (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice.

The effect of citric acid and pasteurization temperature on poly phenol oxidase, total soluble solid and phenol content of stored sugarcane juice are depicted through figure 6 to 7 The concentration of these chemical constituents under refrigerated condition varied from 0.027 to 0.035, 19.1 to 20.5, 14.55 to 14.76%; 0.018 to 0.023, 18.8 to 19.8, 14.95 to 15.16% and 0.015 to 0.024, 18.5 to 19.6, 15.4 to 15.56% at 7,14 and 21 days of storage respectively. Total soluble solids were decreased with increase in storage periods. This might be due to the hydrolysis of sugars present in the juice. Total soluble solids decrease was less in glass bottle during storage. Similar findings were also reported by Chauhan et al. (1997) and Yusuf et al. (2002).

Under ambient condition upon 7 days of storage period of sugarcane juice the polyphenol oxidase, total soluble solid and phenol content values varied from 0.047 to 0.055, 18.8 to 19.8, 14.15 to 14.36% respectively. Similarly on 14 days of storage the same varied from 0.031 to 0.031,18.6 to 19.6; 14.55 to 14.76% respectively. Similarly on 21 days of storage the values of same varied from 0.026 to 0.039, 18.3 to 19.3, 14.95 to 15.16% respectively. The decrease in PPO was due to pasteurization temperatures (85, 90 and 95ºC) since no residual activity was detected in processed samples. Mao (2007) and others reported that PPO activity converts phenolic compounds into brown colored polymers, which causes darkening when sugarcane is crushed. Despite inactivation of PPO during pasteurization alterations in color were still observed. Similar findings were also reported by Chauhan et al. (1997) and Yusuf et al. (2002).

## 5.4 Effect of potassium metabisulfite and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice.

A cursory view of Figure 8 to 9 exhibits that after 7 days of storage period of sugarcane juice under refrigerated condition. The moisture, carbohydrate and ash varied from 75.20 to 81.43%, 13.73 to 16.74%, 0.2 to

0.4% respectively. On 14 days of storage it varied from 77.50 to 85.40%, 13.59 to 17.02%, and 0.2 to 0.6% respectively. Similarly upon 21 days of storage period it varied from 76.40 to 80.12%, 13.92 to 16.40%, and 0.2 to 0.4% respectively.

Under ambient condition of storage of sugarcane juice the moisture, carbohydrate and ash content showed variation from 77.81 to 81.74%, 13.78 to 17.23% and 0.2 to 0.4% (7 days) 77.40 to 85.10%, 13.78 to 16.60%, 0.2 to 0.4% (14 days) and 76.50 to 81.75%, 13.38 to 18.33% and 0.2 to 0.6% (21 days) of storage period respectively. The similar findings were also reported by Chauhan et al. (1997) and Yusuf et al. (2002).

## 5.5 Effect of potassium metabisulfite and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice.

Findings of experiments are depicted through figure 10 to 11. Under refrigerated condition at 7 days of storage period of sugarcane juice, the effect of potassium metabisulfite and pasteurization temperature on total sugar, reducing sugar and titrable acidity values found to be 16.78 to 22.62%; 0.209 to 0.258%; 0.27 to 0.51% respectively. Similarly on 14 days of storage the values of same varied from 16.73 to 22.56%; 0.266 to 0.370%; 0.36 to 0.60% respectively. Finally upon 21 days of storage period it varied from 16.69 to 22.50%; 0.374 to 0.657%; 0.43 to 0.68 %respectively.

The effect of potassium metabisulfite and pasteurization temperature on total sugar, reducing sugar and titrable acidity of sugarcane juice under ambient condition during 7 days of storage period varied from 15.50 to 23.61%; 0.212 to 0.255%; 0.28 to 0.53% respectively. Similarly on 14 days of storage it varies from 15.00 to 23.56%; 0.271 to 0.370%; 0.37 to 0.62% respectively. Upon 21 days of storage period the values of total sugar, reducing sugar and titrable acidity varied from 14.49 to 23.51%; 0.407 to 0.679%; 0.45 to 0.70% respectively. The present findings of sugar content are in conformity with reported results of Chauhan et al. (1997) and Hesham et al. (2010).

## 5.6 Effect of potassium metabisulfite and pasteurization temperature on poly phenol oxidase (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice.

The results reveals that (Figure 12 to 13 ) under refrigerated condition at 7 days of storage period of sugarcane juice the effect of potassium metabisulfite and pasteurization temperature on polyphenol oxidase, total soluble solid and phenol values varied from 0.034 to 0.048; 18.20 to 19.90; 14.14 to 14.45 %respectively. Upon 14 days of storage the same varied from 0.025 to 0.045; 18.00 to 19.70; 14.54 to 14.85% respectively. Similarly on 21 days of storage period it varied from 0.027 to 0.041; 17.70 to 19.50; 14.94 to 15.25 %respectively.

On 7 days (ambient condition) of storage period of sugarcane juice effect of potassium metabisulfite and pasteurization temperature on polyphenol oxidase, total soluble solid and phenol values shows that it varies from 0.047 to 0.055; 18.8 to 19.8; 14.15 to 14.36% respectively. Upon 14 days of storage it varied from 0.031 to 0.031; 18.6 to 19.6; 14.55 to 14.76 % respectively. And on 21 days of storage period the same varied from 0.026 to 0.039; 18.3 to 19.3; 14.95 to 15.16% respectively. The present findings are in conformity with reported results of Chauhan et al. (1997) and Hesham et al. (2010)

## 5.7 Effect of Potassium sorbate and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice.

Findings depicted through figure (14 to 15) indicates that under refrigerated condition. The moisture, carbohydrate and ash content, values varied from 75.90 to 81.20%,13.50 to 16.74%, 0.2 to 0.4%;77.20 to 84.63%,13.06 to 16.88%,0.2 to 0.4%; 76.40 to 80.79%, 13.92 to 17.23% and 0.2 to 0.4 % at 7, 14 and 21 days storage respectively.

Under ambient condition the effect of potassium sorbate and pasteurization temperature on moisture, carbohydrate and ash values shows that it varies from 76.58 to 80.57%; 13.78 to 15.76%; 0.2 to 0.4% respectively at 7 days of storage period of sugarcane juice. Similarly on 14 days of storage, the same varied from 77.85 to 83.47%; 13.73 to 17.16% and 0.2 to 0.4% respectively. And upon 21 days of storage period it varied from 76.72 to 81.75%; 12.19 to 19.10%; 0.2 to 0.4 % respectively.

## 5.8 Effect of potassium sorbate and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice.

The effect of potassium sorbate and pasteurization temperature on total sugar, reducing sugar and titrable acidity are shown through figure 16 to 17. They varied from 16.78 to 22.62%, 0.209 to 0.258%, 0.27 to 0.51%; 16.73 to 22.56%, 0.266 to 0.370%, 0.36 to 0.60 %and 16.69 to 22.50%, 0.374 to 0.657%, 0.43 to 0.68% respectively on 7,14 and 21 days of storage period respectively.

The effect of these treatments under ambient conduits of storage shows that total sugar, reducing sugar and titrable acidity values varied from 15.21 to 21.88%, 0.204 to 0.255%, 0.28 to 0.53%; 15.15 to 21.84%, 0.258 to 0.374%, 0.27 to 0.62% and 15.11 to 21.80%, 0.407 to 0.599% and 0.35 to 0.70 % at 7, 14 and 21 days of storage of sugarcane juice.

## 5.9 Effect of Potassium sorbate and pasteurization temperature on poly phenol oxidease (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice.

In refrigerated condition at Figure 18 to 19 days of storage period of sugarcane juice the effect of potassium sorbate and pasteurization temperature on polyphenol oxidase, total soluble solid and phenol content, exhibits from 0.031 to 0.035; 18.30 to 20.70; 14.52 to 14.87% respectively. Same varied from 0.025 to 0.029; 18.00 to 20.50; 14.92 to 15.27% respectively on 14 days of storage period. Similarly upon 21 days of storage period it varied from 0.026 to 0.028; 17.80 to 20.20; 15.32 to 15.67% respectively.

Under ambient condition, effect of potassium sorbate and pasteurization temperature on polyphenol oxidase, total soluble solid and phenol on sugarcane juice at 7 days of storage period, shows that values varied from 0.029 to 0.035; 18.20 to 20.50; 14.12 to 14.47% respectively. On

14 days of storage period the same varied from 0.025 to 0.032; 18.00 to 20.20; 14.52 to 14.87 respectively. And upon 21 days of storage period the values of total sugar, reducing sugar and titrable acidity varied from 0.025 to 0.032; 18.00 to 19.50; 14.92 to 15.27 % respectively.

### 5.10 Effect of ascorbic acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice.

Figure 20 to 21 shows that under refrigerated condition 7 days of storage period of sugarcane juice the effect of ascorbic acid and pasteurization temperature on moisture, carbohydrate and ash content, values varied from 75.40 to 81.20%; 13.73 to 16.27%; 0.2 to 0.4% respectively. Same varied from 76.54 to 84.60%; 13.59 to 15.70%; 0.2 to 0.6 % respectively on 14 days of storage period. And upon 21 days of storage period it varied from 76.24 to 82.25%; 13.73 to 17.23%; 0.2 to 0.6% respectively.

The effect of ascorbic acid and pasteurization temperature on moisture, carbohydrate and ash content at ambient condition at 7 days of storage period of sugarcane juice the values varied from 76.32 to 78.00%; 13.64 to 16.67%; 0.2 to 0.4 % respectively. Upon 14 days of storage it varied from 78.00 to 84.60%; 13.59 to 16.53%; 0.2 to 0.4% respectively. Similarly, the same varied from 76.50 to 81.40%; 13.92 to 18.41%; 0.2 to 0.4% respectively 21 days of storage period. The present findings are in conformity with reported results of Chauhan et al. (1997) and Hesham et al. (2010)

### 5.11 Effect of ascorbic acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice.

Figure 22 to 23 indicates that under refrigerated condition at 7 days of storage period of sugarcane juice the effect of ascorbic acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity values varied from 15.63 to 22.62%; 0.204 to 0.247%; 0.26 to 0.51% respectively. Similarly, it varied from 15.58 to 22.57%; 0.258 to 0.370%; 0.35 to 0.60% respectively on 14 days of storage. And upon 21 days of storage period its values varied from 15.47 to 22.53%; 0.443 to 0.679%; 0.43 to 0.67% respectively.

The effect of ascorbic acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity under ambient storage condition at 7 days of storage period of sugarcane juice, the values varied from 15.79 to 21.30%; 0.204 to 0.256%; 0.28 to 0.53% respectively. Similarly, its value varied from 15.74 to 21.25%; 0.275 to 0.351%; 0.27 to 0.62% respectively on 14 days of storage. Upon 21 days of storage period the values of total sugar, reducing sugar and titrable acidity varied from 15.70 to 21.20%; 0.407 to 0.608%; 0.35 to 0.70 %respectively. The present findings are in conformity with reported results of Chauhan et al. (1997) and Hesham et al. (2010)

### 5.12 Effect of ascorbic acid and pasteurization temperature on poly phenol oxidease (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice.

A cursory view of the findings figure 24 to 25, showed that under refrigerated condition on 7 days of storage period of sugarcane juice on the effect of ascorbic acid and pasteurization temperature on polyphenol oxidase, total soluble solid and phenol values varied from 0.029 to 0.034; 18.30 to 20.40; 14.62 to 14.76% respectively. Upon 14 days of storage same varied from 0.023 to 0.031; 18.00 to 19.80; 15.02 to 15.16% respectively. Similarly the values of total sugar, reducing sugar and titrable acidity varied from 0.022 to 0.029; 17.00 to 19.50; 15.42 to 15.56% respectively on 21 days of storage period.

Under ambient storage condition the effect of ascorbic acid and pasteurization temperature of stored sugarcane juice on the polyphenol oxidase, total soluble solid and phenol content, values varied from 0.049 to 0.054; 18.00 to 20.40; 14.22 to 14.36% respectively on 7 days of storage period. The same varied from 0.030 to 0.043; 17.70 to 20.10; 14.62 to 14.76 % respectively on 14 days of storage. And upon 21 days of storage period the values varied from 0.026 to 0.032; 17.30 to 19.70; 15.02 to 15.16 % respectively. The present findings are in conformity with reported results of Chauhan et al. (1997) and Hesham et al. (2010)

### 5.13 Effect of chemical preservatives and pasteurization temperature on total plate count of stored sugarcane juice.

Figure 26 shows that Citric acid and pasteurization temperature exhibits significant effect on total plate count at refrigerated and ambient condition. It varied from 1.72 to 1.78 cfu & 1.82 to 1.88 cfu; 1.9 to 1.98 cfu and ambient condition 1.78 to 2.12 cfu; and 1.86 to 2.06 cfu & 1.99 to 2.16 cfu respectively at 7, 14 & 21 days of storage period of sugarcane juice.

Figure 27 shows the effect of potassium metabisulphite and pasteurization temperature on total plate count at refrigerated and ambient condition on 7, 14 & 21 days of storage period of sugarcane juice, It varied from 1.78 to 2.12 cfu; 1.80 to 2.15cfu & 1.92 to 1.17 cfu; and 1.90 to 1.98 cfu & 14.94 to 15.25 cfu respectively.

The effect of potassium sorbate and pasteurization temperature on total plate count of stored sugarcane juice at refrigerated and ambient condition for 7, 14 & 21 days varied from 1.60 to 1.68 cfu & 13.14 to 13.45 cfu; 1.70 to 1.78 cfu & 13.55 to 13.85 cfu; and 1.80 to 1.88 cfu & 13.94 to 14.25 cfu respectively (Figure 28).

The effect of ascorbic acid and pasteurization temperature on total plate count of stored sugarcane juice at refrigerated and ambient condition for 7,14 and 21 days varied from 1.99 to 1.72 to 2.05;. 1.78 to 1.94 to 1.76 to 2.2 1.80 to2.4 respectively (Figure 29).

### 5.14 Effect of chemical preservatives and pasteurization temperature on sensor quality attributes of stored sugarcane juice.

#### 5.14.1 Effect of citric acid and pasteurization temperature on overall acceptability sensory score of stored sugarcane juice.

The effect of citric acid and pasteurization temperature on overall acceptability sensory score of stored sugarcane juice at ambient and refrigerated condition is presented through Figure 30 ($5^0$ and $30^0$C). It varies from 8.46 to 8.86, 8.35 to8.78, 8.29 to 8.67 and 8.35 to 8.74, 8.26 to8.6 and 8.17 to 8.45 at 7, 14 and 21 days stored sugarcane juice under refrigerated and ambient condition respectively. The stored sugarcane juice under both conditions of storage have received the sensory score above 8.0 which comes under category of liked very much catagory.

### 5.14.2 Effect of potassium metabisulfite and pasteurization temperature on overall acceptability sensory score of stored sugarcane juice.

The effect of levels of potassium metabisulfite and pasteurization on overall acceptability sensory score of stored sugarcane juice at ambient and refrigerated condition varies from 8.85 to 8.90, 8.61 to 8.75 and 8.34 to 55 and 8.53 to 8.85, 8.34 to 8.73, 8.25 to 8.58 at 7, 14 and 21 days storage sugarcane juice under refrigerated and ambient conditions respectively. The table also reveals that stored sugarcane juice under both conditions of storage have again received the sensory score above 8.0 which comes under category of liked very much. Figure 31 ($5^0$ and $30^0$C).

### 5.14.3 Effect of potassium sorbate and pasteurization temperature on Overall acceptability sensory score of stored sugarcane juice.

The results of effect of potassium sorbate and pasteurization temperature on overall acceptability sensory score of stored sugarcane juice at ambient and refrigerated condition is presented through fig 32. It varies from 8.57 to 8.84, 8.34 to 8.71 and 8.20 to 8.52 at 7, 14 and 21 days store sugarcane juice under refrigerated conditions. While the mean value of sensory score at ambient condition of storage were found to be 8.54 to 8.76, 8.43 to 8.67 and 8.34 to 8.57 at 7, 14 and 21 days stored sugarcane juice. Figure 32 ($5^0$ and $30^0$C).

### 5.14.4 **Effect of ascorbic acid and pasteurization temperature on Overall acceptability sensory score of stored sugarcane juice.**

A findings presented through figure33 ($5^0$ and $30^0$C) indicates that effect of ascorbic acid and pasteurization temperature on overall acceptability sensory score of stored sugarcane juice at ambient and refrigerated condition. The mean value varies from 8.68 to 8.94, 8.67 to 8.85, 8.46 to 8.76 and 8.36 to 8.65, 8.25 to 8.57, 8.16 to 8.48 at 7.14 and 21 days storage of sugarcane juice respectively. The stored sugarcane juices under both conditions of storage have again received the sensory score above 8.0 which comes under category of liked very much. The present findings of acceptable sensory score are in conformity with reported results of Chauhan et al. (1997) and Hesham et al. (2010)

In a nutshell it is reduced from the findings of present investigation and their justification that different treatment combination of preservatives with pasteurization temperature can be successfully utilized for development of preserved bottled sugarcane juice without sacrificing the quality of product. The preservation technology has got great potential for value addition in food processing industries. The standardized optimum condition of can be successfully translated at commercial scale for domestic and commercial application.

**Fig.1 Chemical Composition of sugarcane juice.**

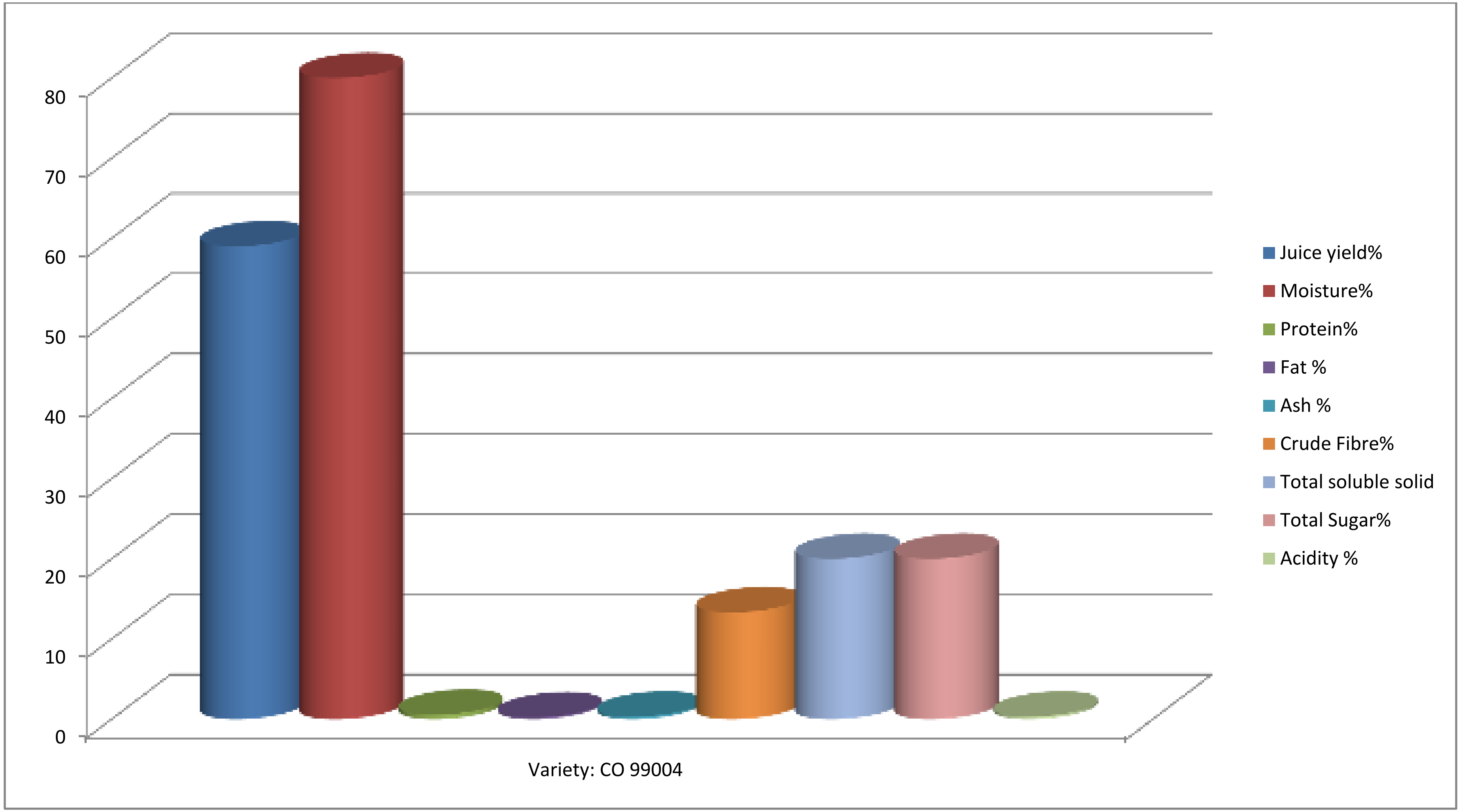


**Fig. 2** **Effect of citric acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at refrigerated condition (5° C)**

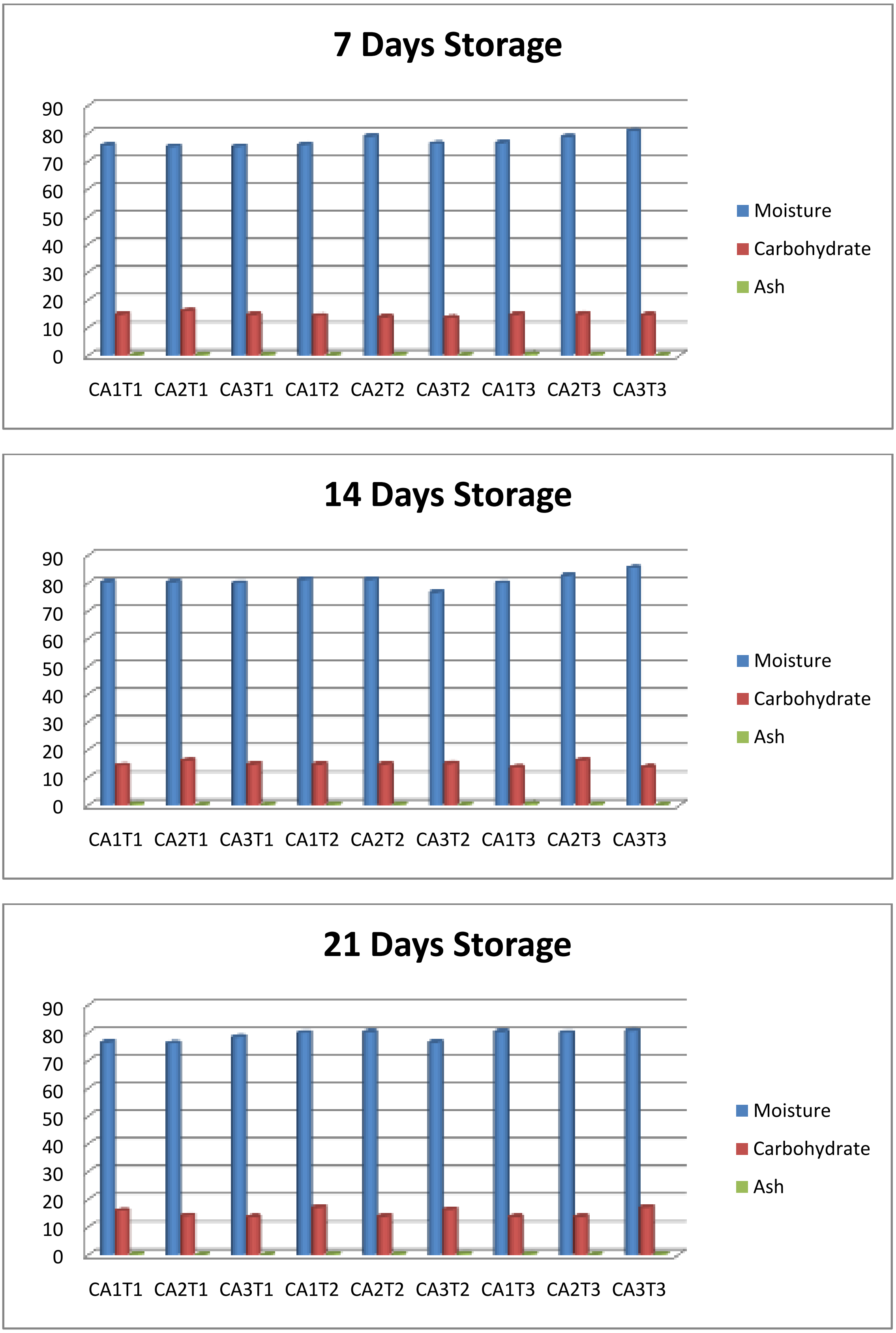
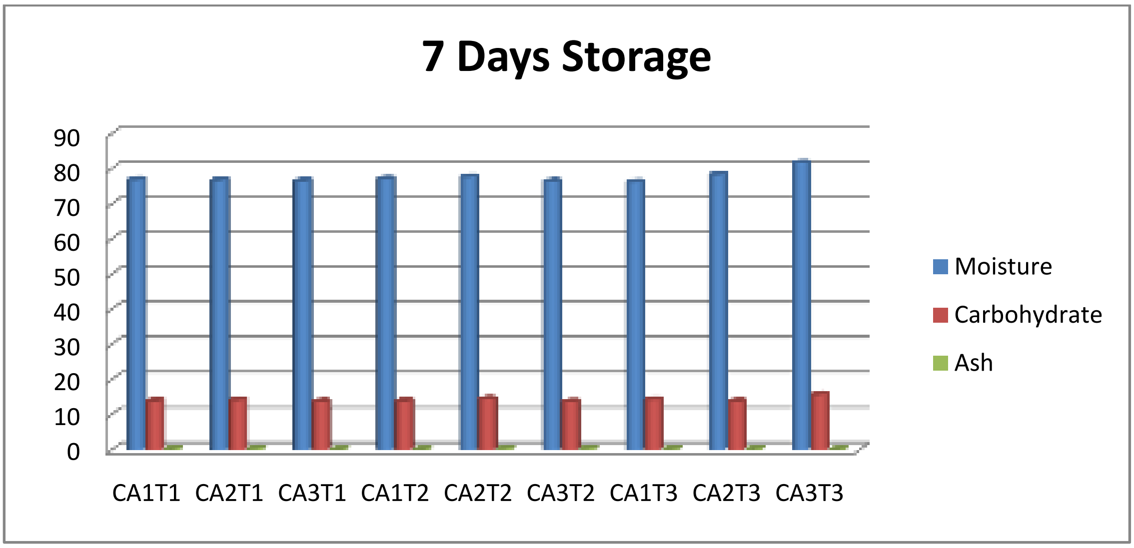
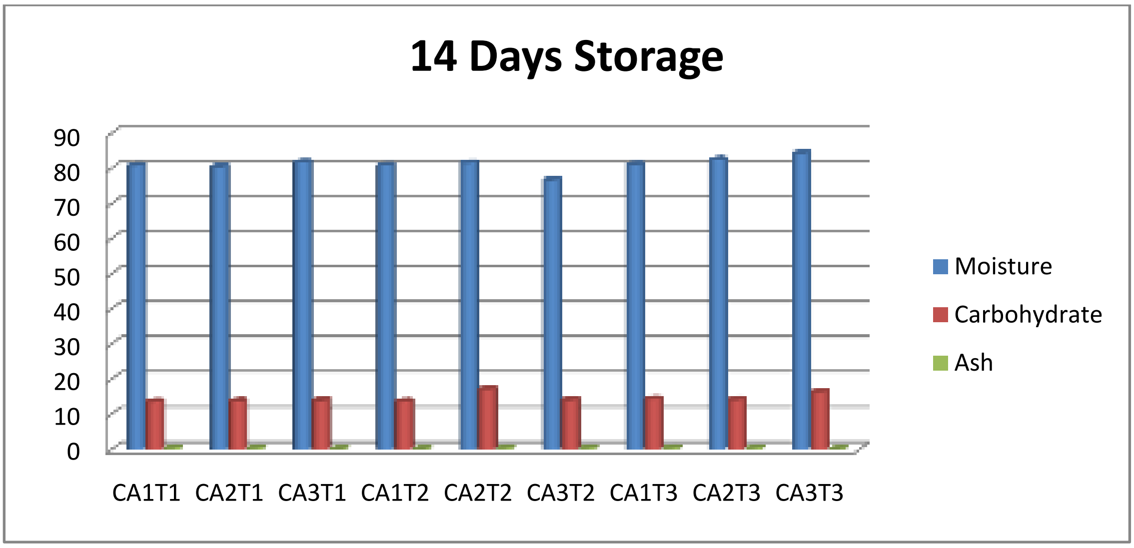


**Fig. 3 Effect of citric acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at ambient condition (30° C)**



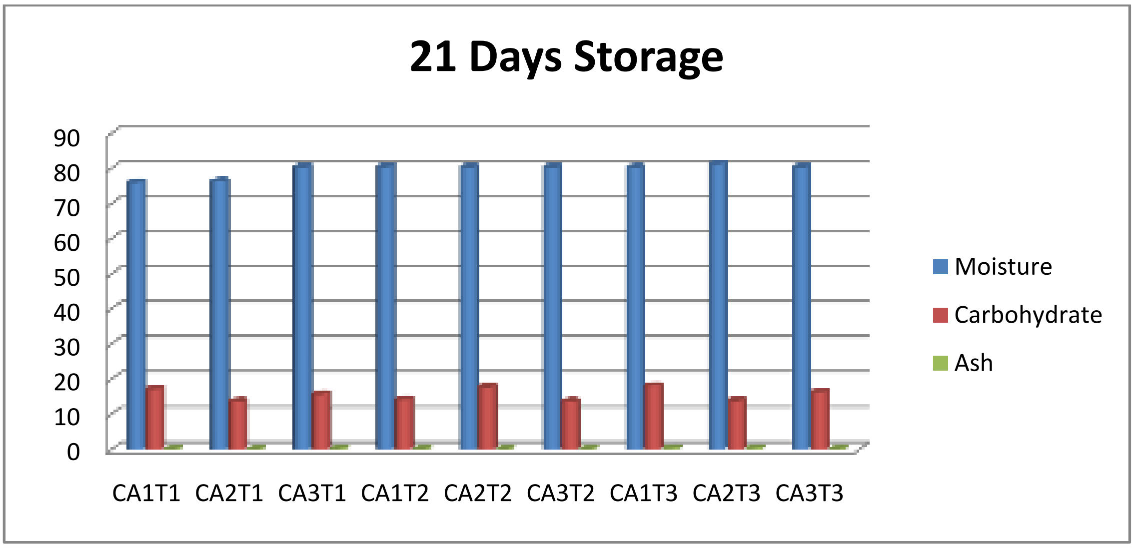



**Fig. 4 Effect of citric acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition (5° C)**

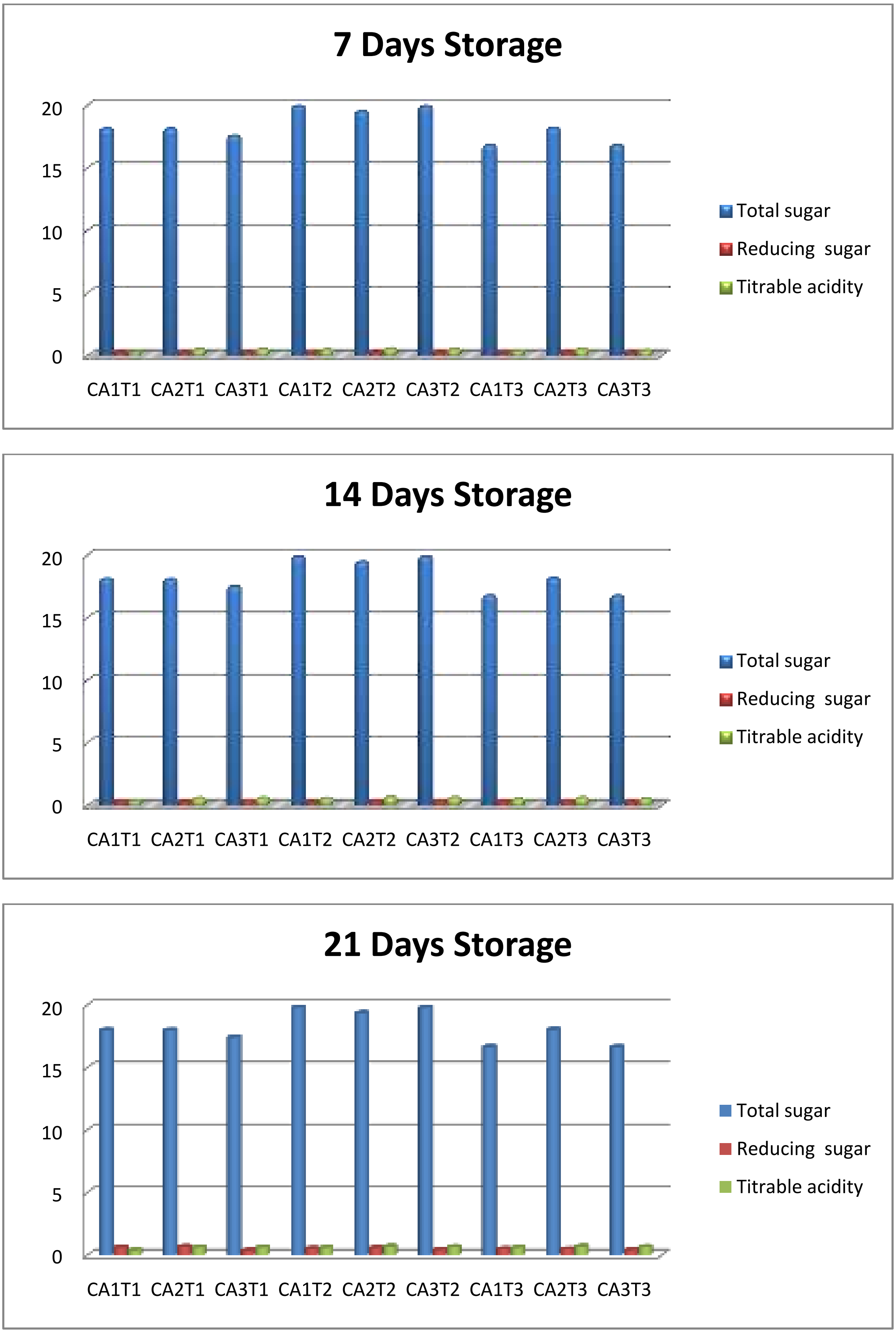
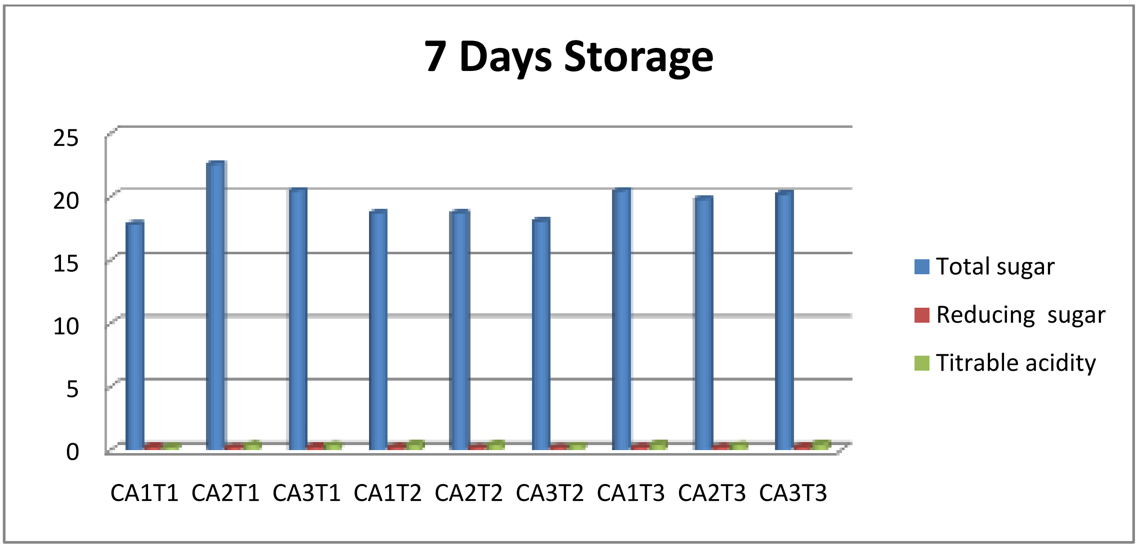
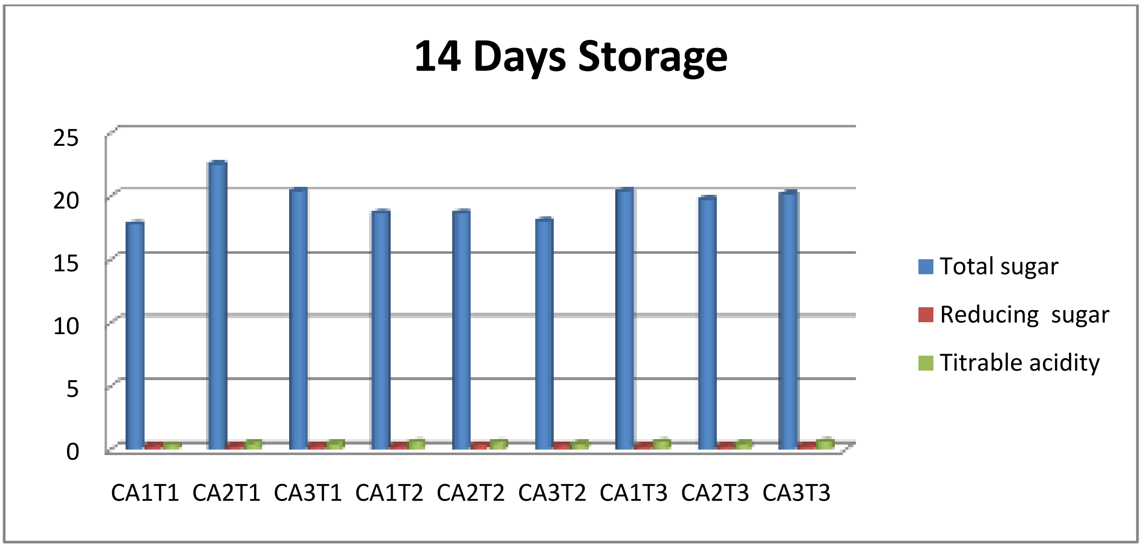


**Fig. 5** **Effect of citric acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition (30° C)**



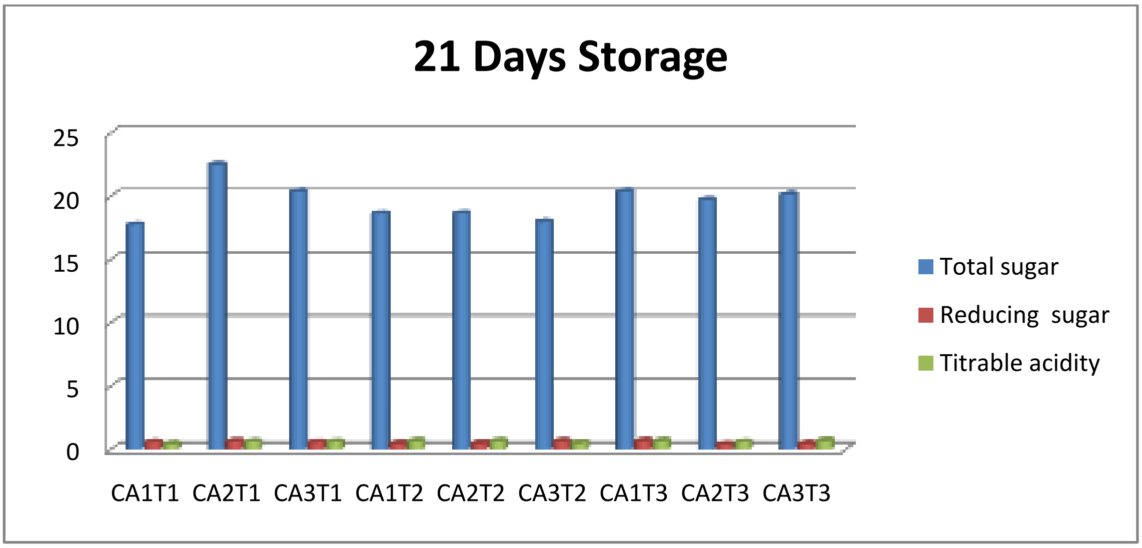
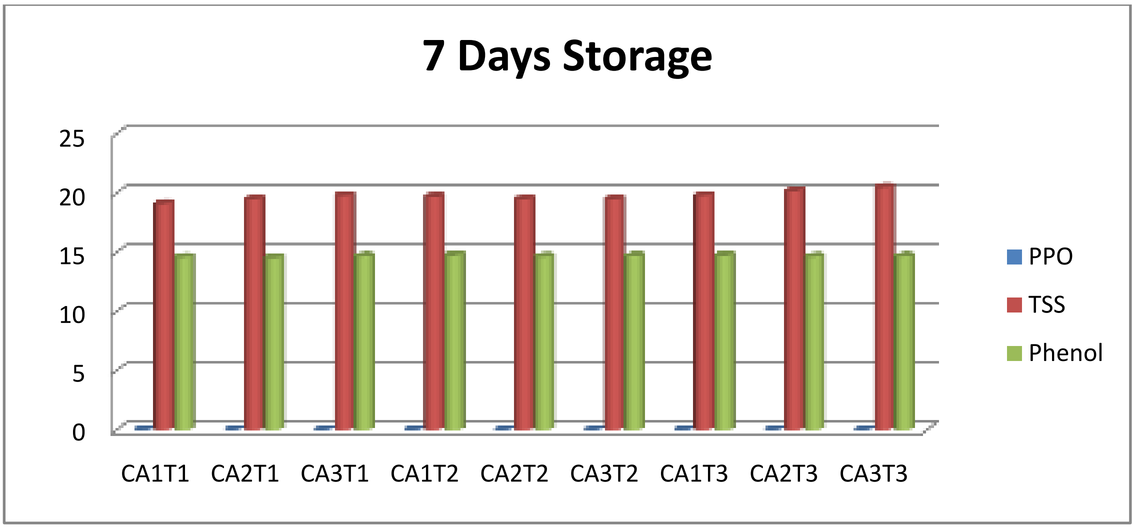
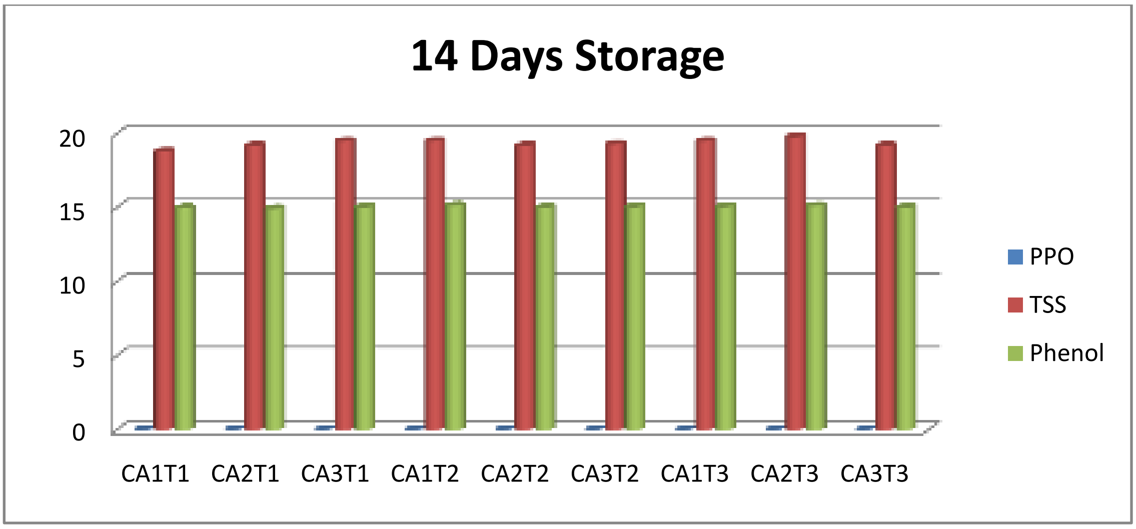



**Fig. 6 Effect of citric acid and pasteurization temperature on poly phenol oxidase (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice at refrigerated condition (5° C)**



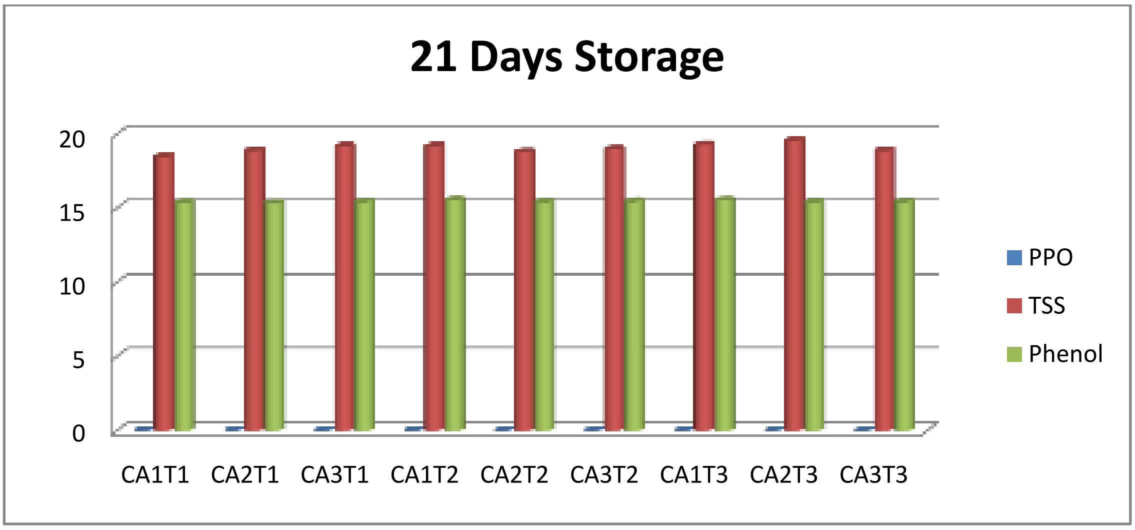
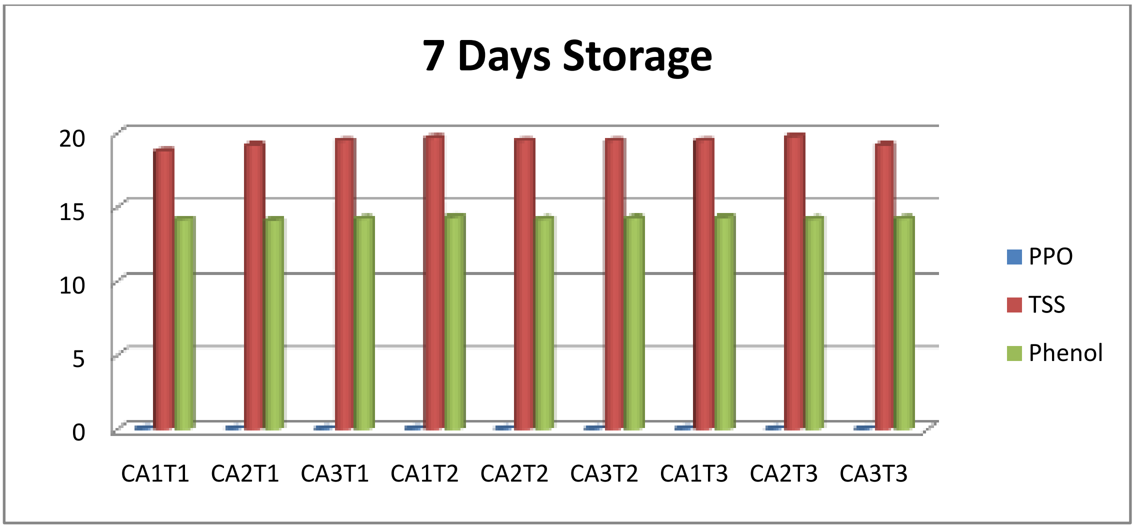
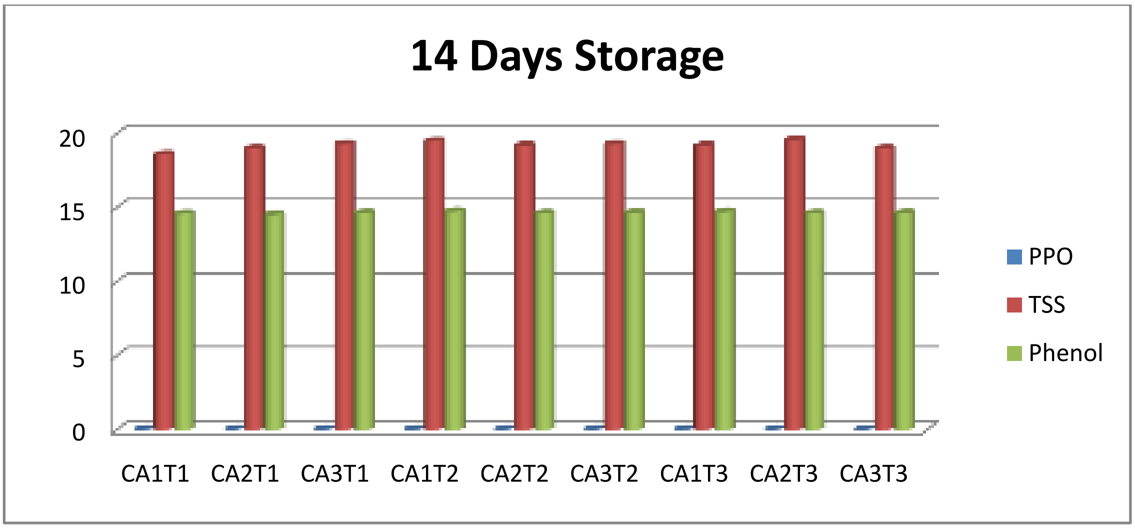



**Fig. 7 Effect of citric acid and pasteurization temperature on poly phenol oxidase (PPO) total soluble solids (TSS) and phenol content of stored sugarcane juice at ambient condition (30°C)**



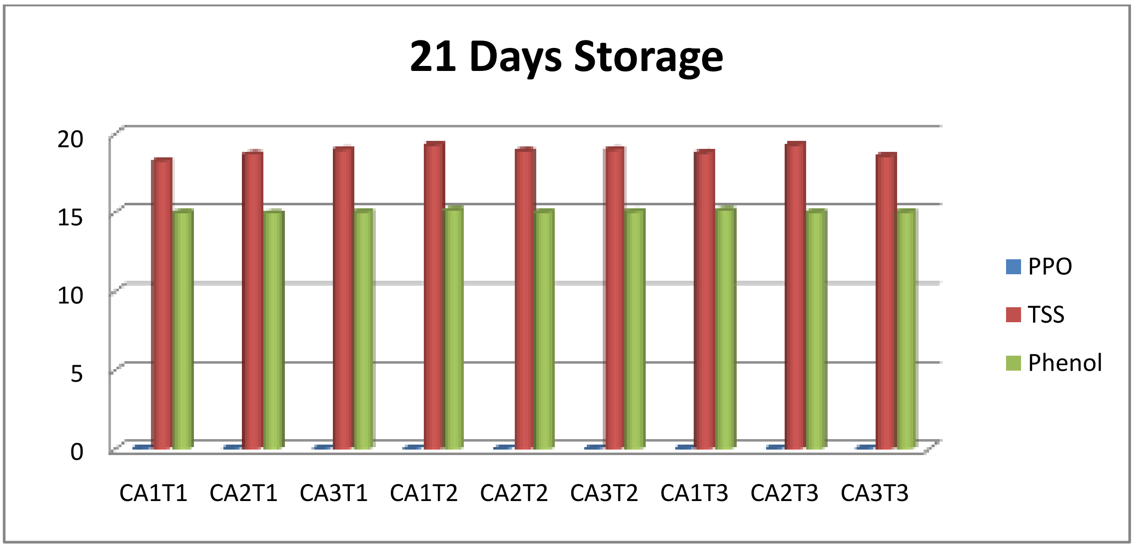
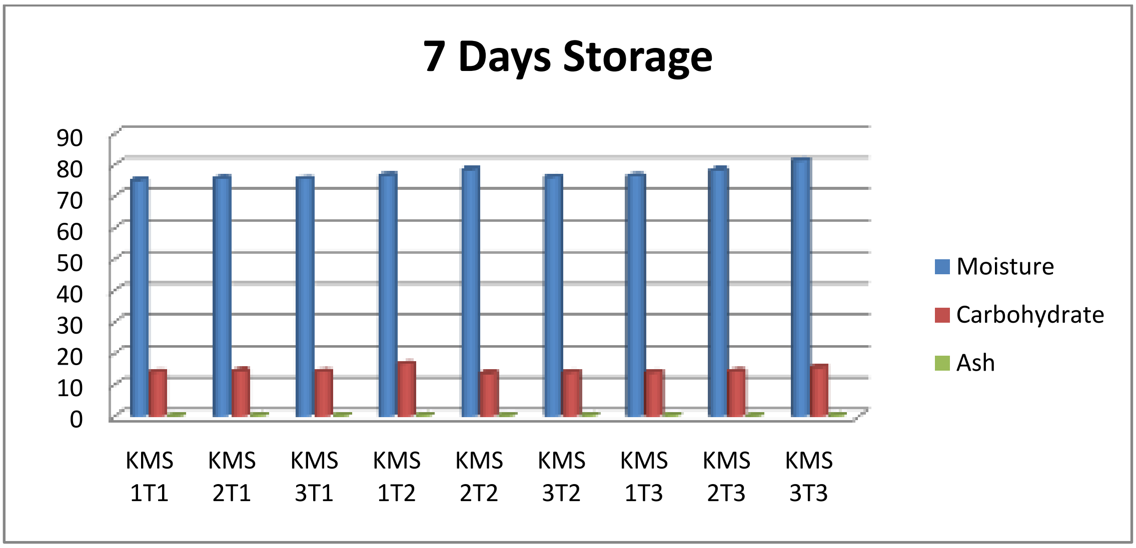
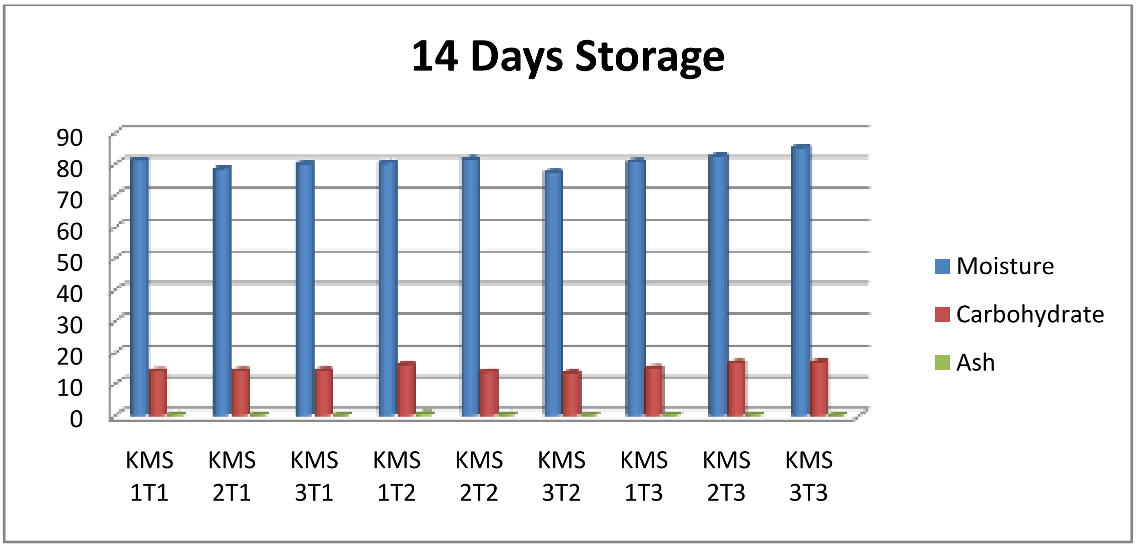



**Fig. 8** **Effect of potassium metabisulfite and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at refrigerated condition (5°C)**



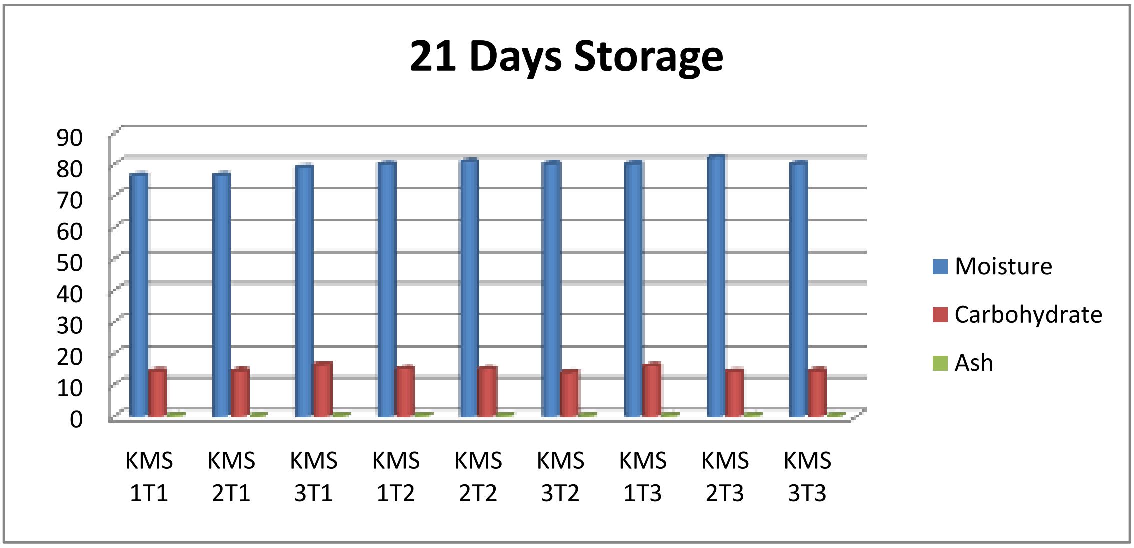



**Fig. 9** **Effect of potassium metabisulfite and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at refrigerated condition (30 °C)**

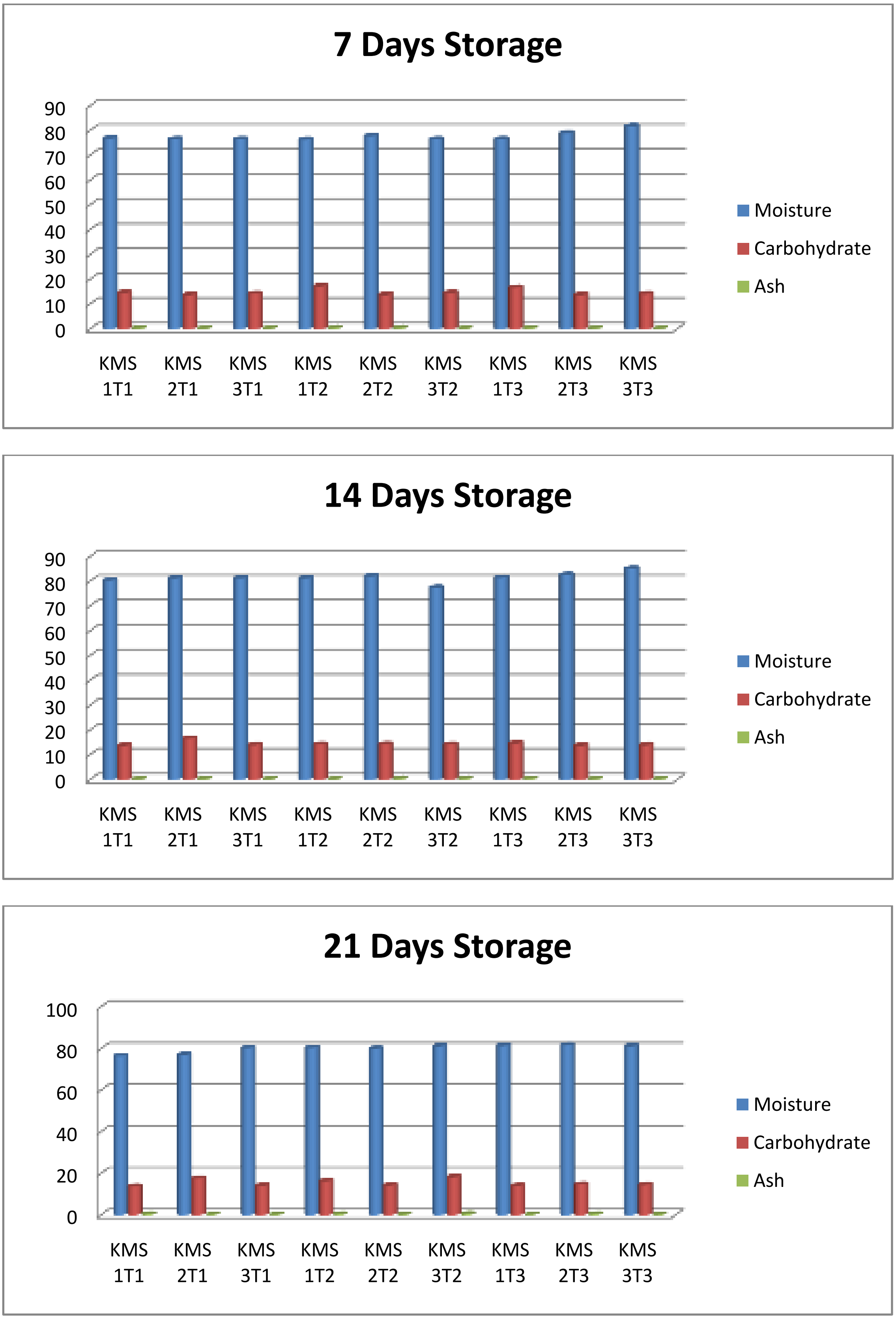


**Fig. 10 Effect of potassium metabisulfite and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition (5° C)**

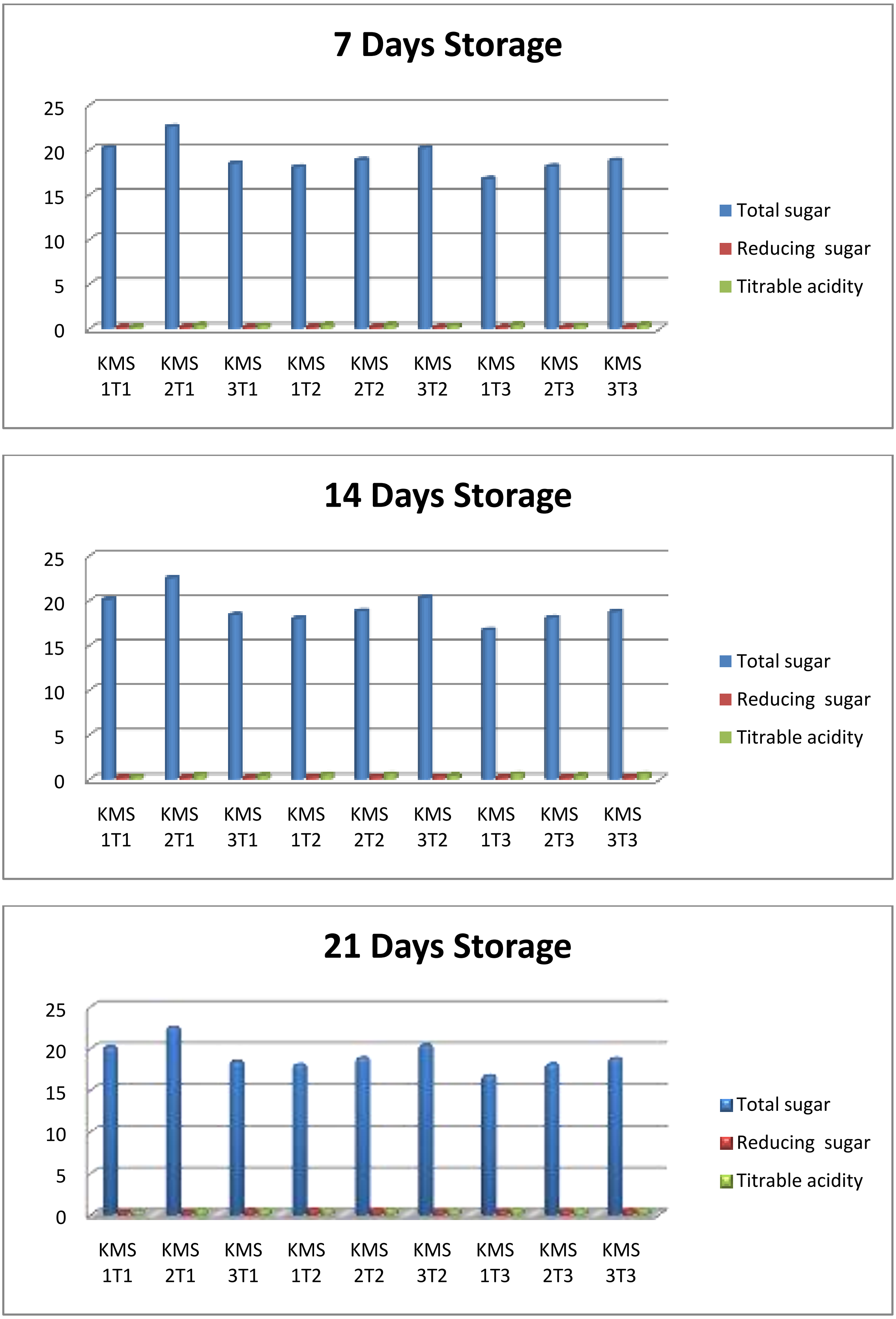
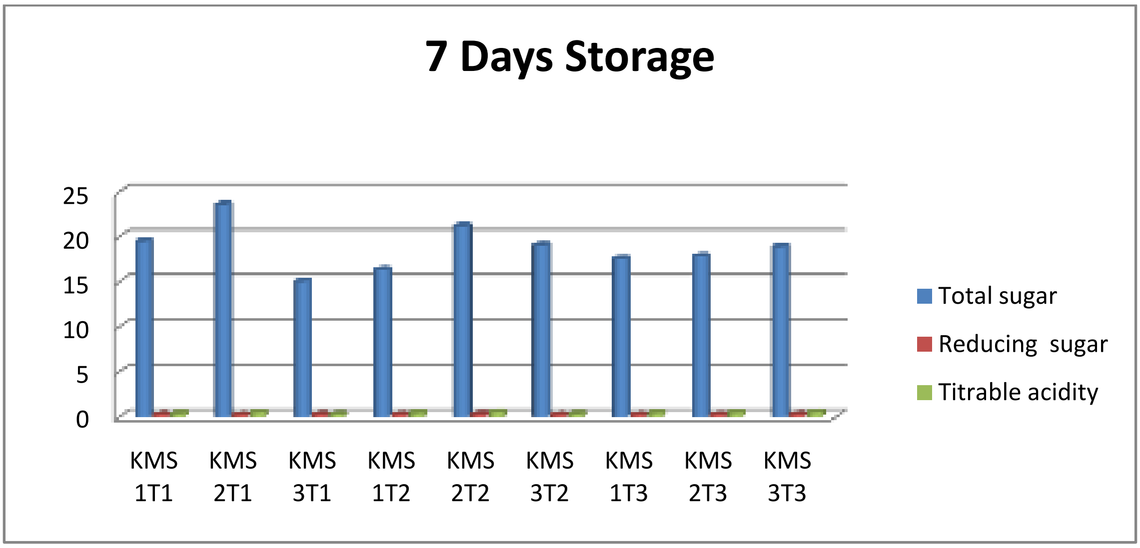
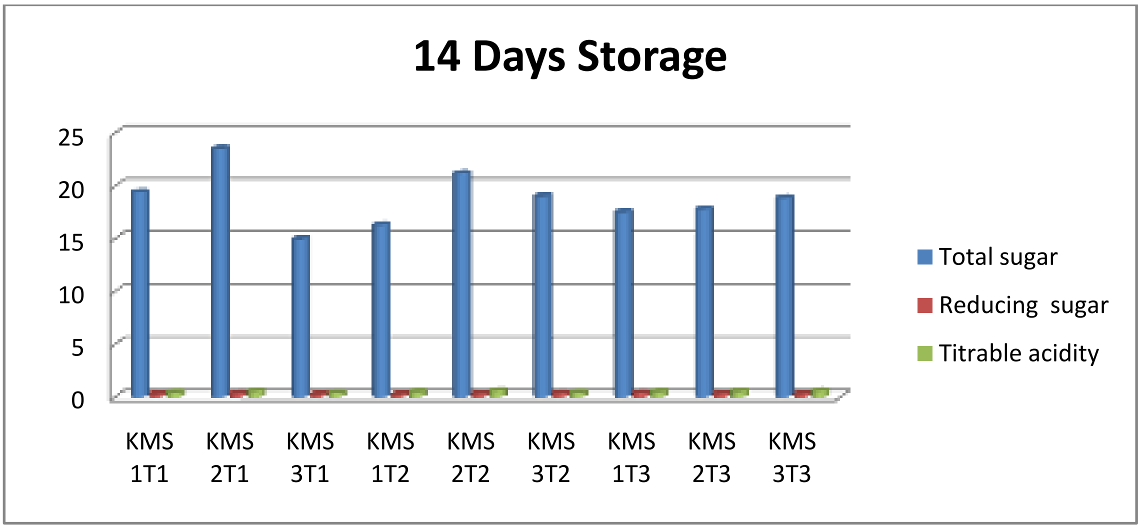


**Fig. 11 Effect of potassium metabisulfate and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition (30° C)**



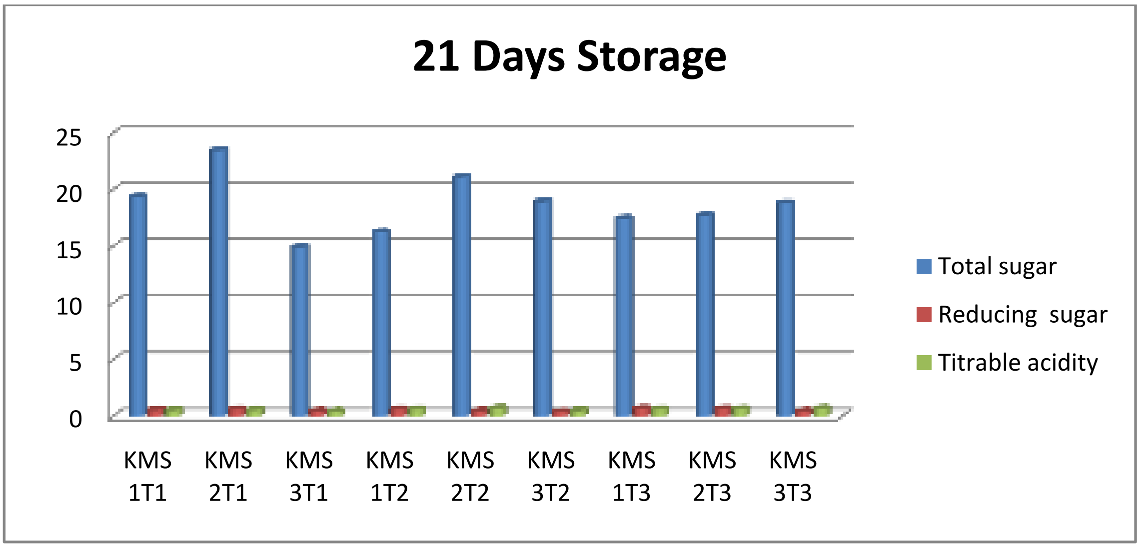
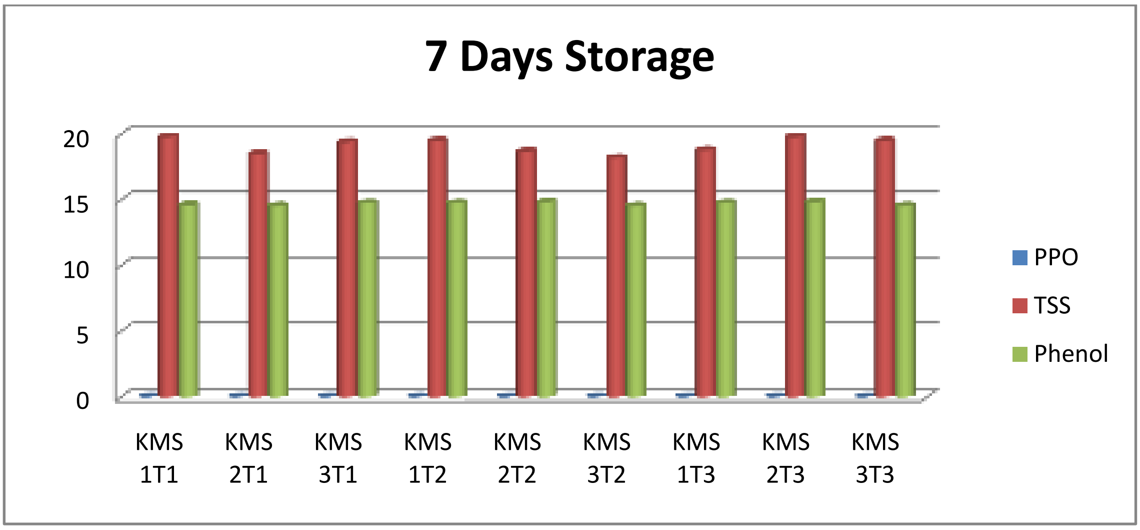
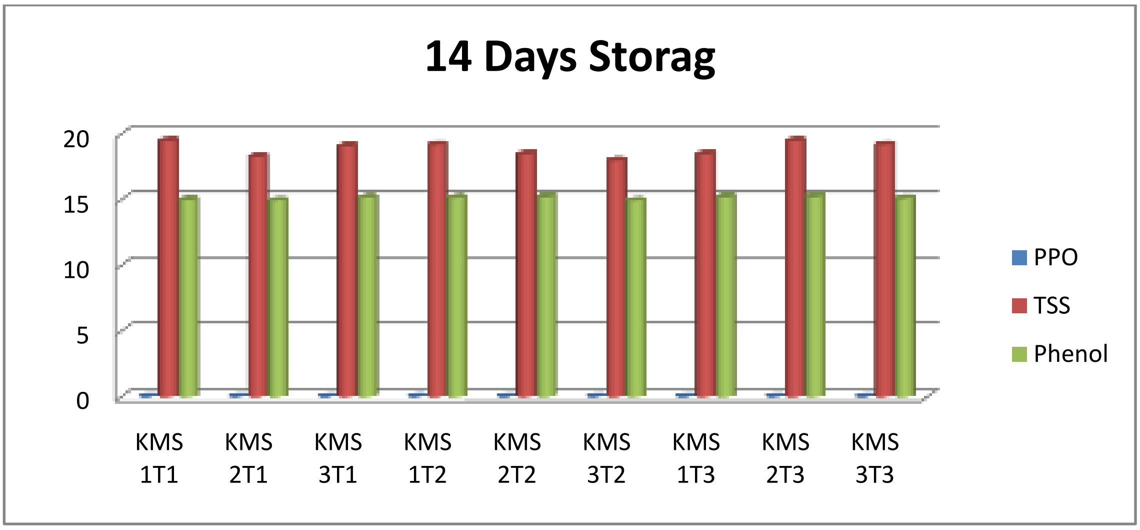



**Fig. 12 Effect of potassium metabisulfite and pasteurization temperature on poly phenol oxidase (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice at refrigerated condition ($5^0C$)**



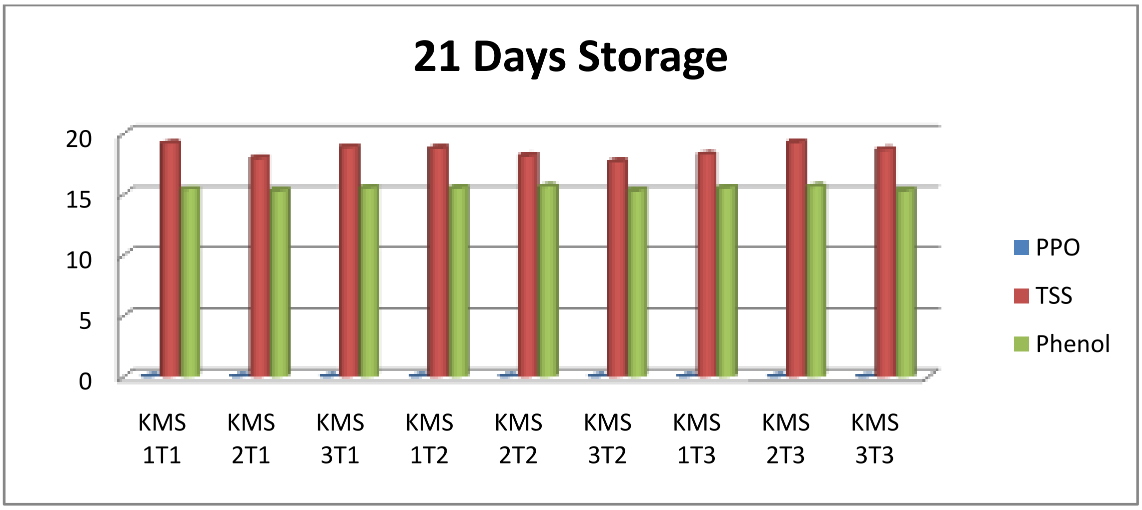
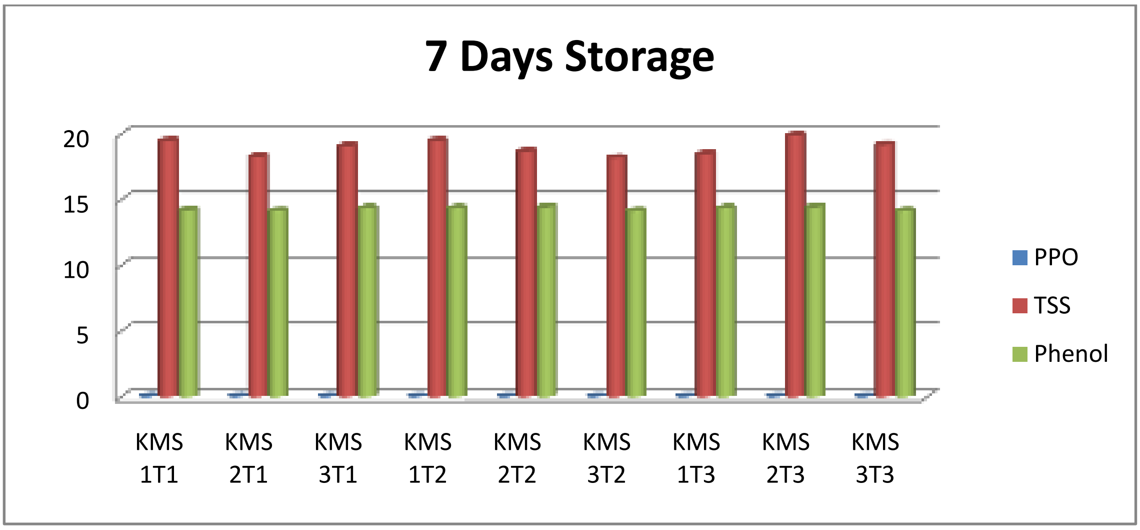
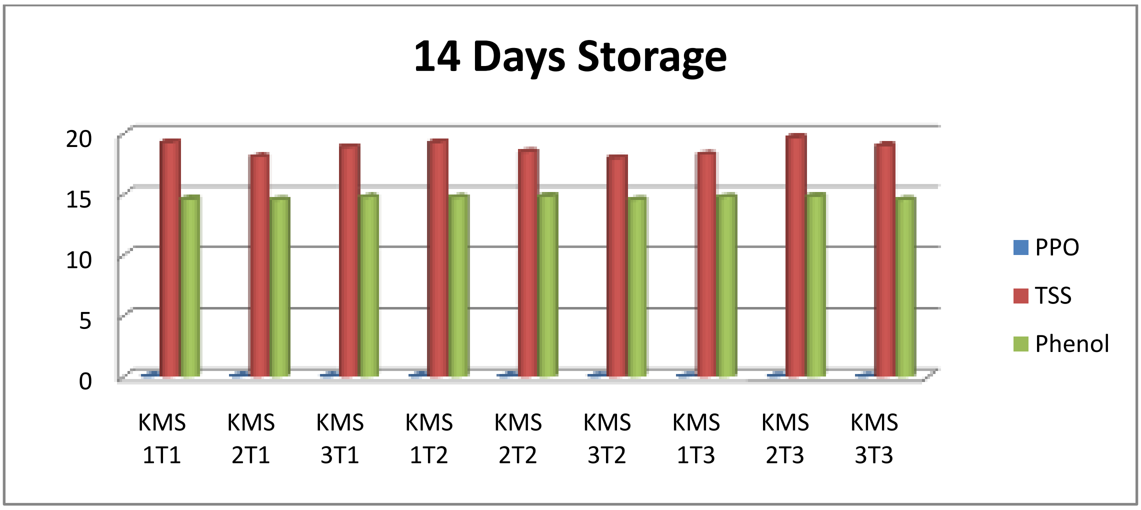



**Fig. 13 Effect of potassium metabisulfite and pasteurization temperature on poly phenol oxidase (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice at ambient condition (30° C)**



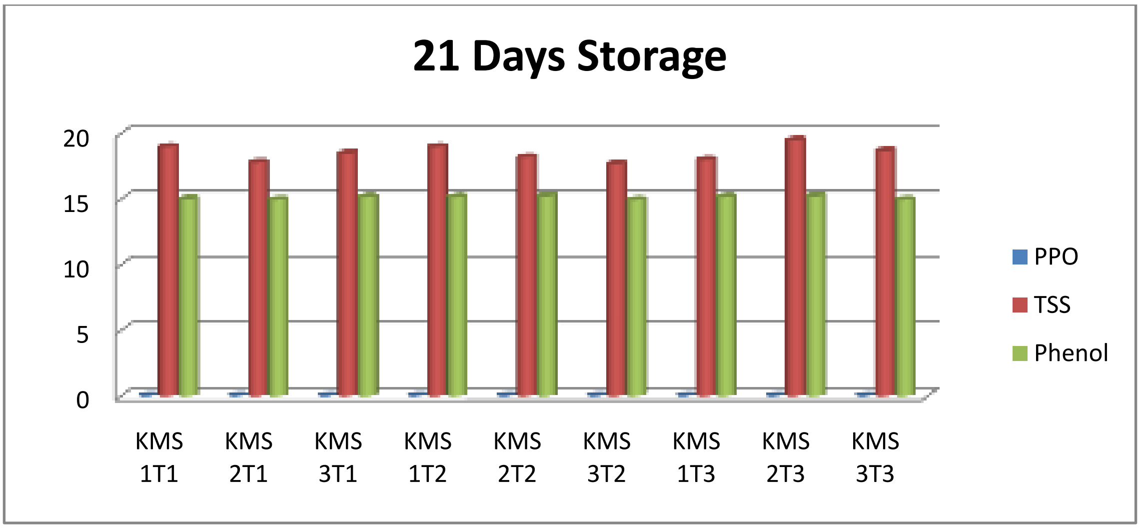



**Fig. 14** **Effect of potassium sorbate and pasteurization temperature on moisture, carbohydrate and ash of stored sugarcane juice at refrigerated condition (5°C)**

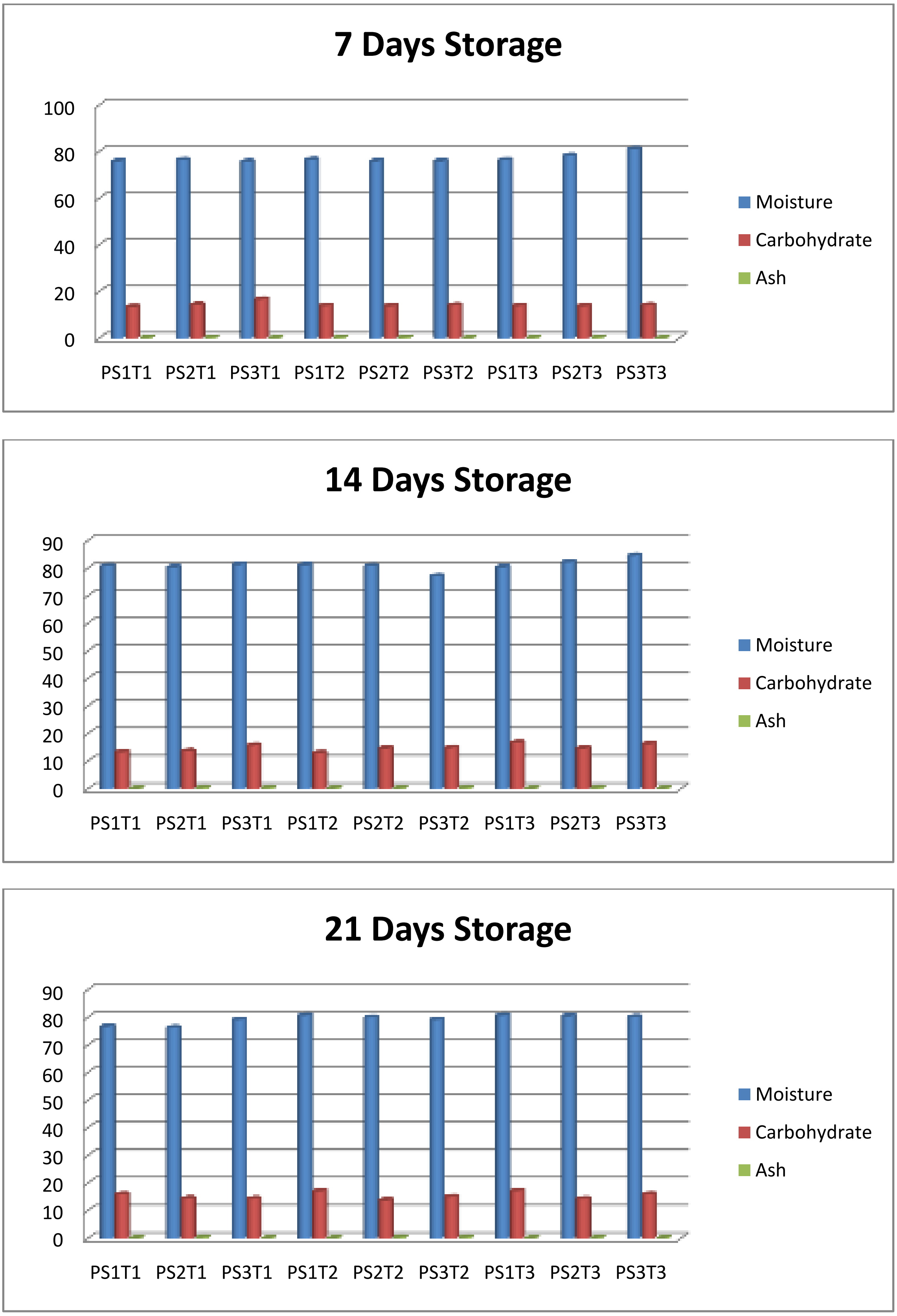
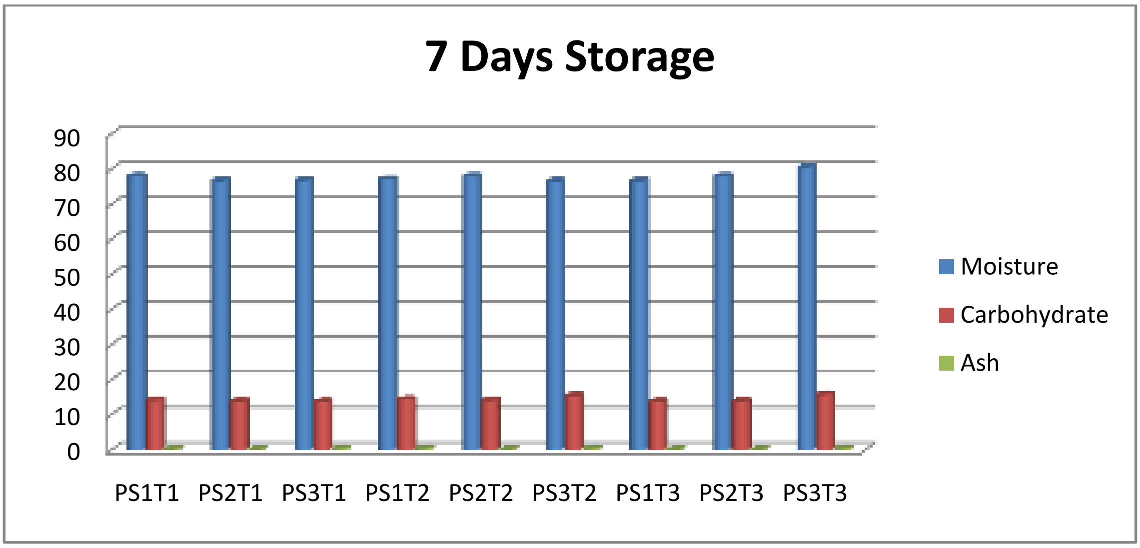
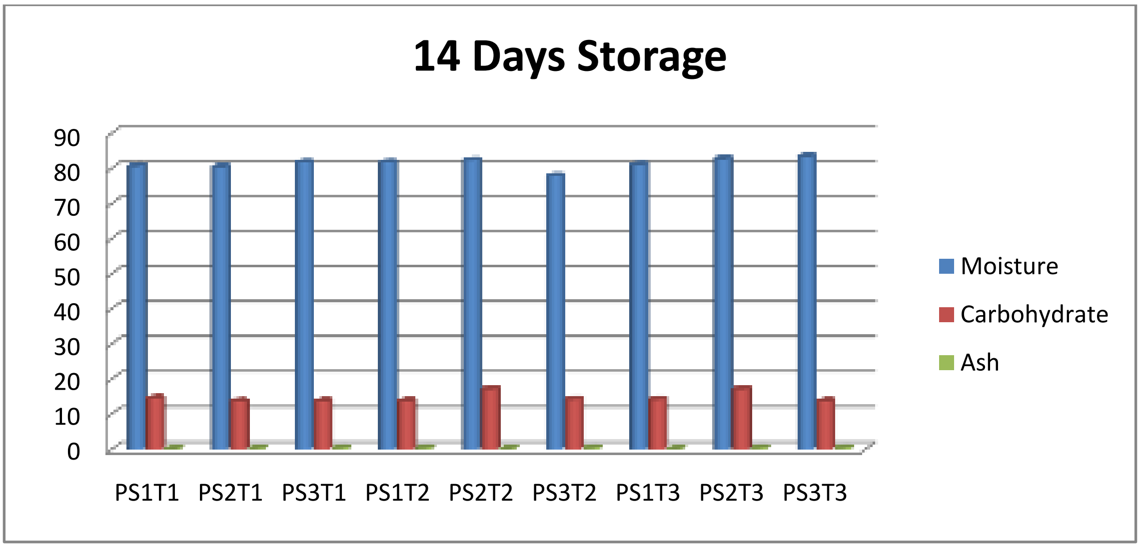


**Fig. 15 Effect of potassium sorbate and pasteurization temperature on moisture, carbohydrate and ash of stored sugarcane juice at ambient condition (30°C)**



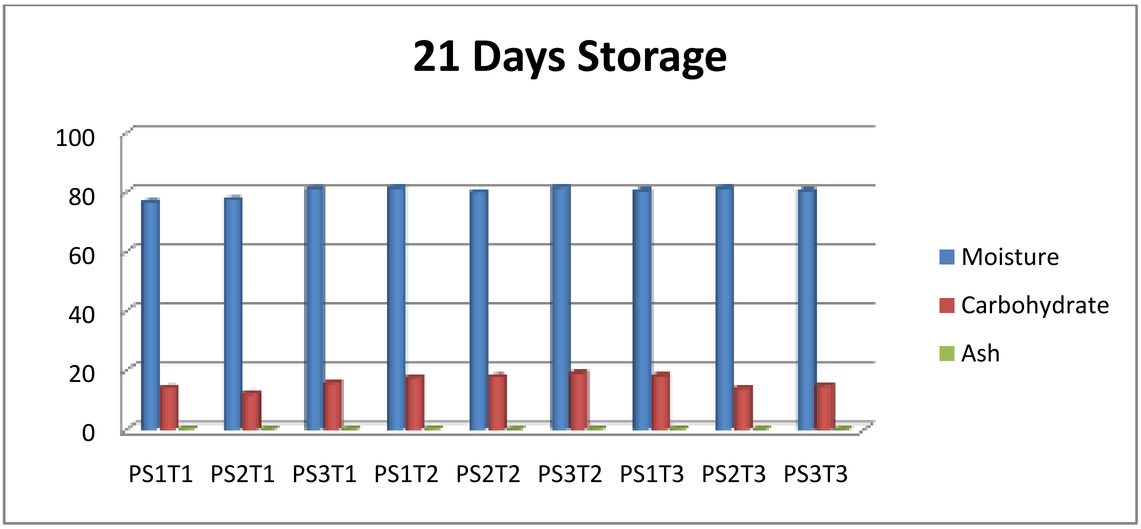
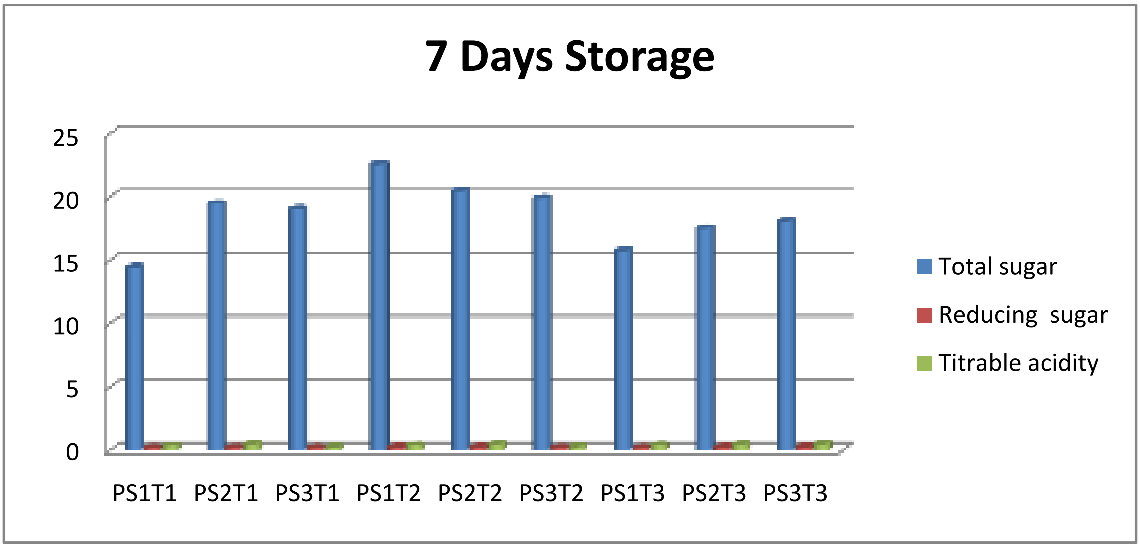
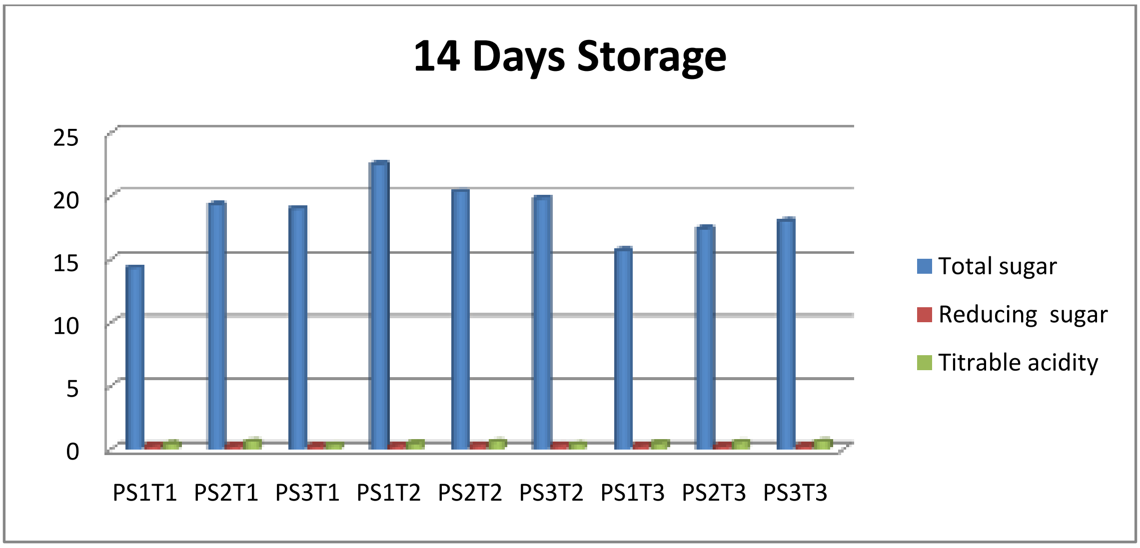



**Fig. 16 Effect of potassium sorbate and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition (5°C)**



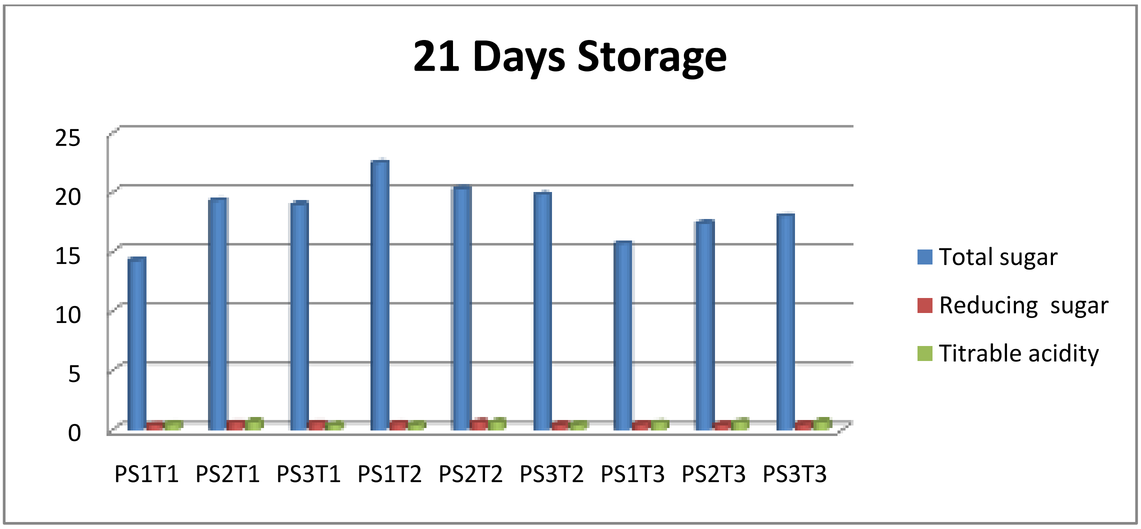
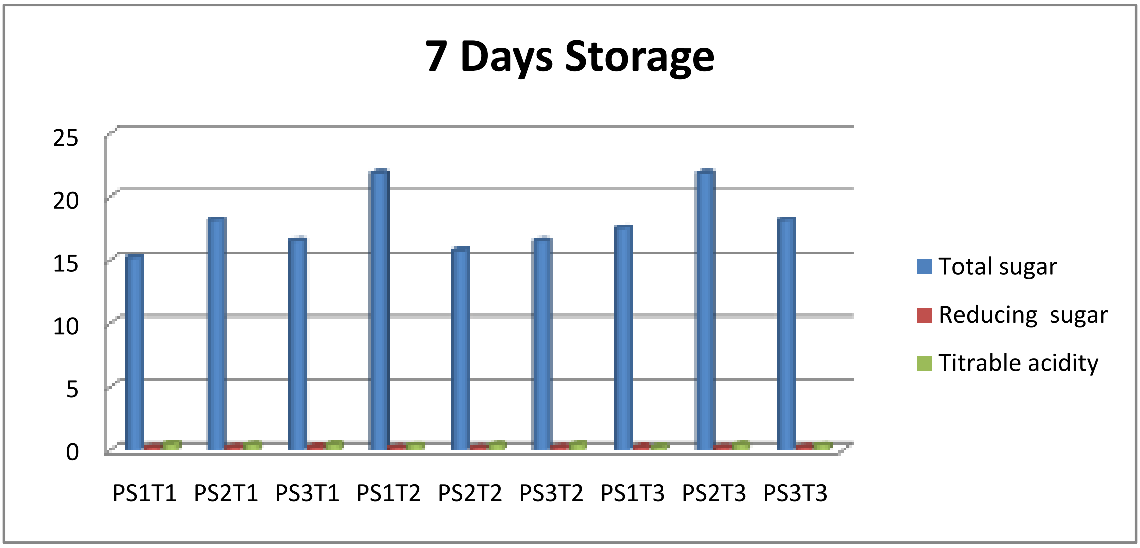
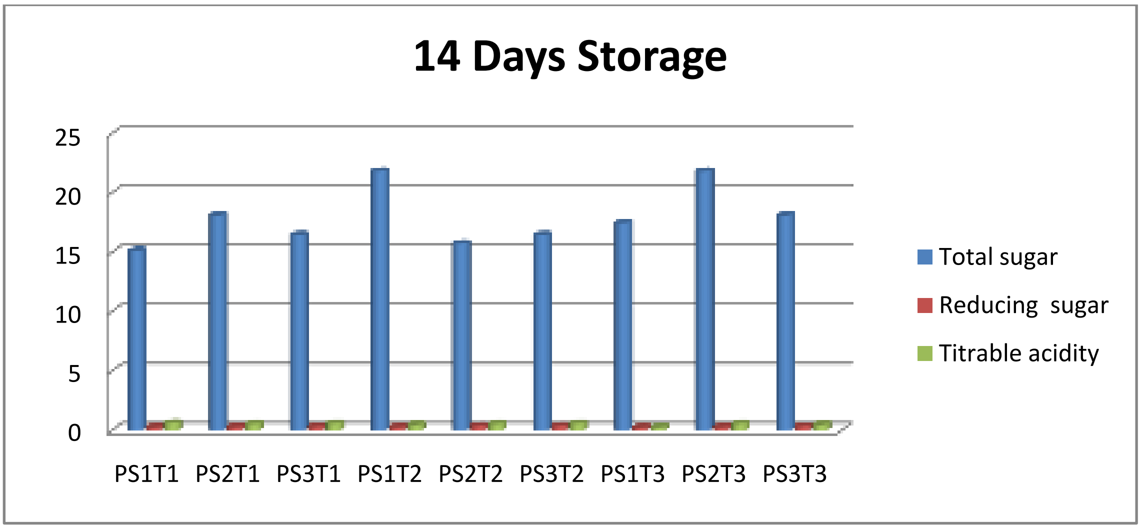



**Fig. 17** **Effect of potassium sorbate and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition (30°C)**



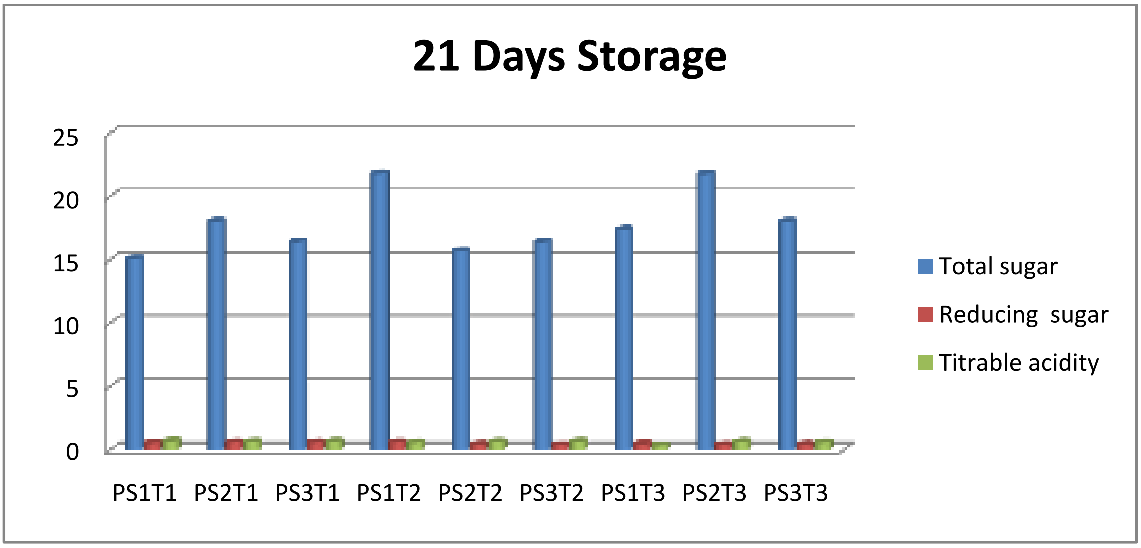
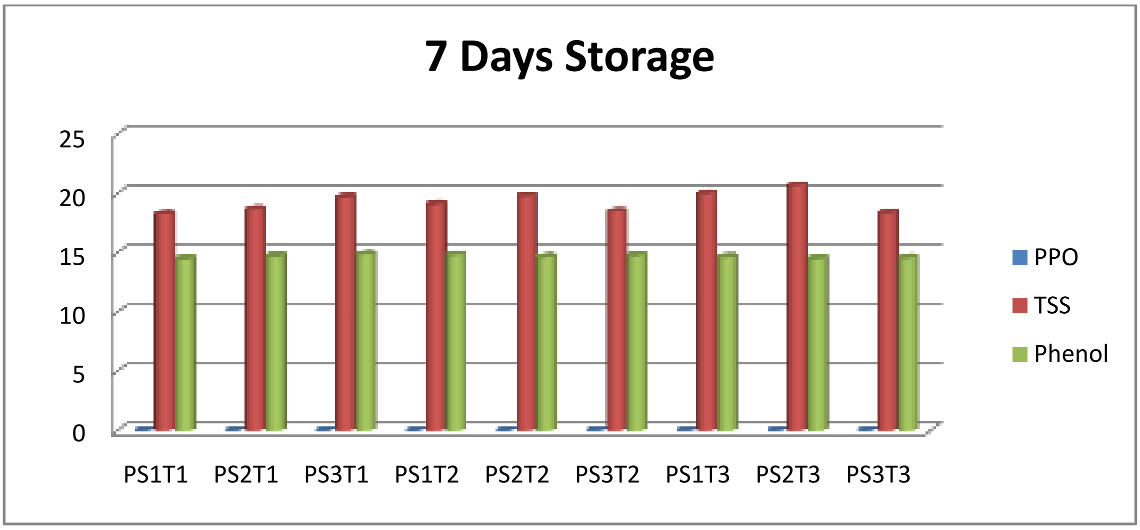
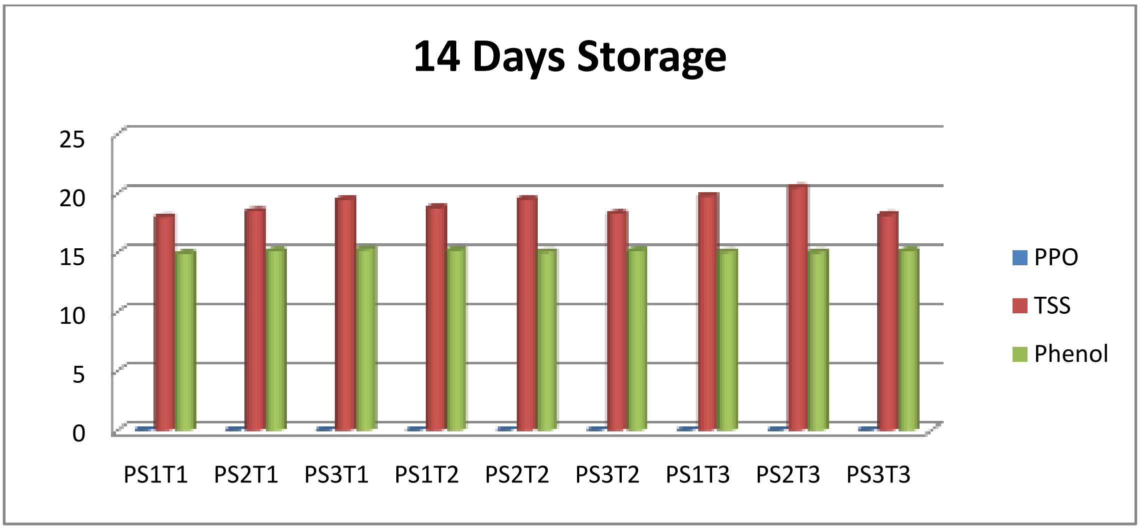



**Fig. 18** **Effect of potassium sorbate and pasteurization temperature on poly phenol oxidase (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice at refrigerated condition (5°C)**



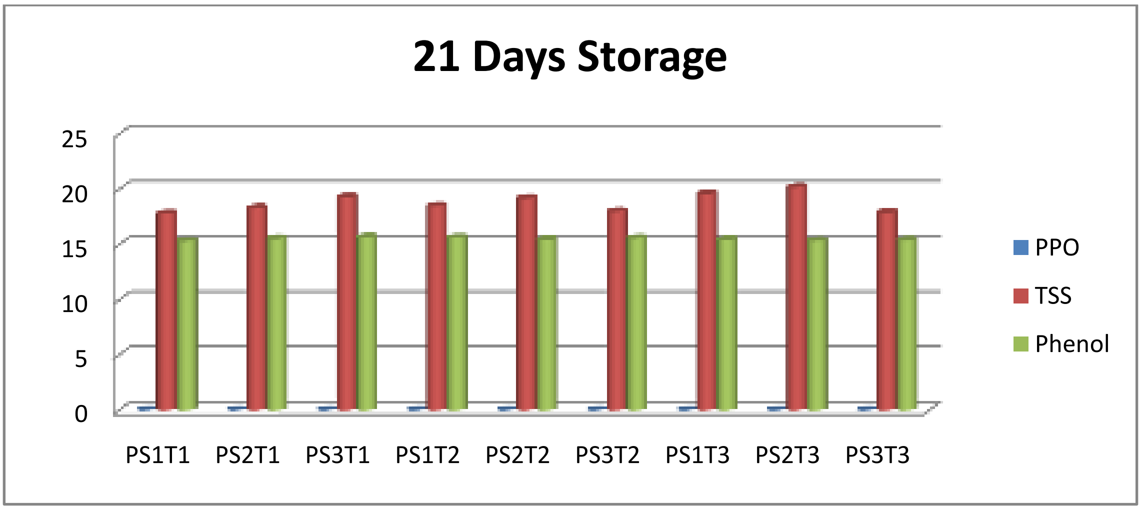
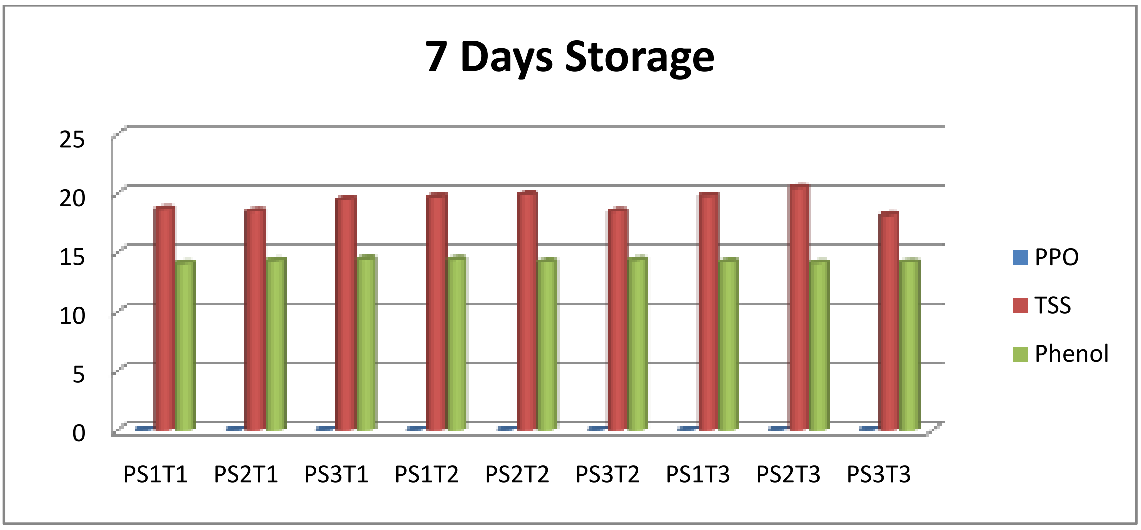
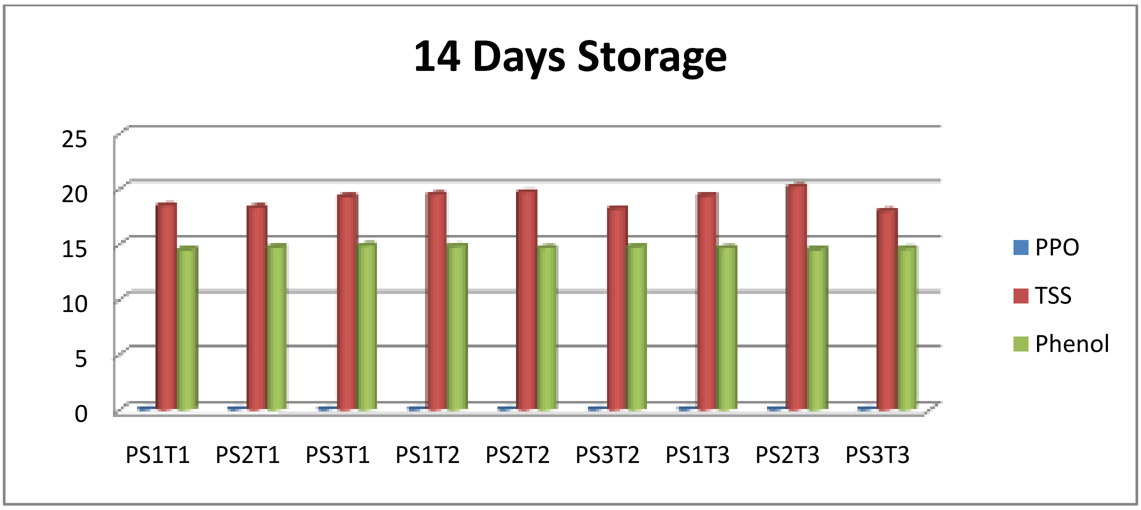



**Fig. 19** **Effect of potassium sorbate and pasteurization temperature on poly phenol oxidase (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice at ambient condition (30° C)**



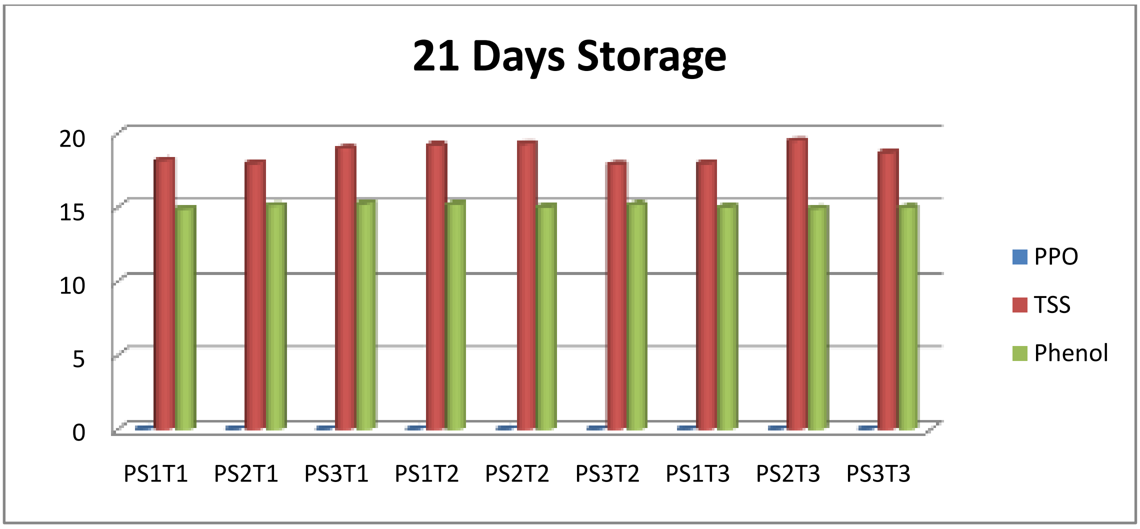
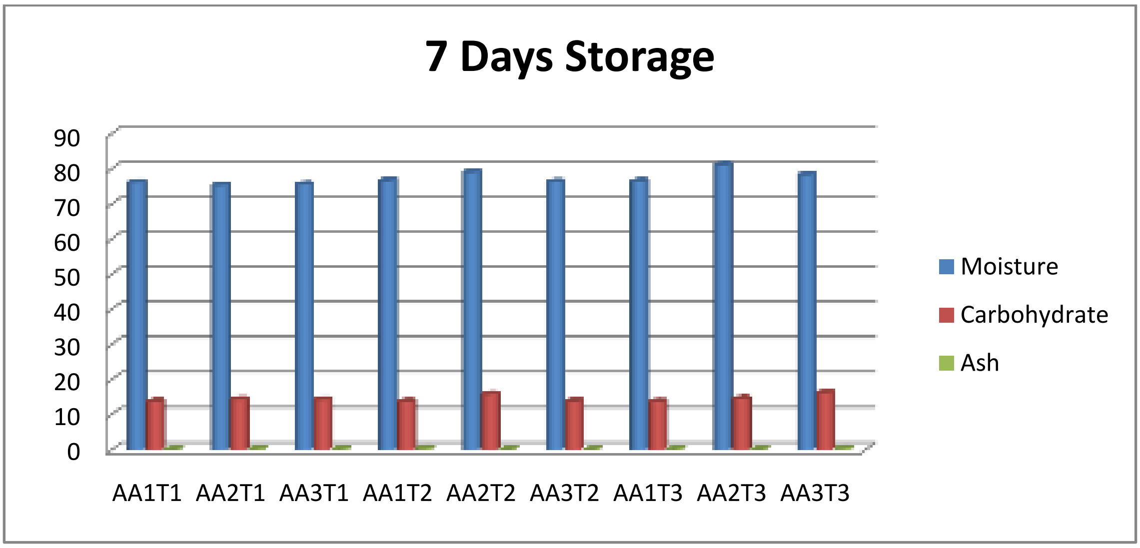
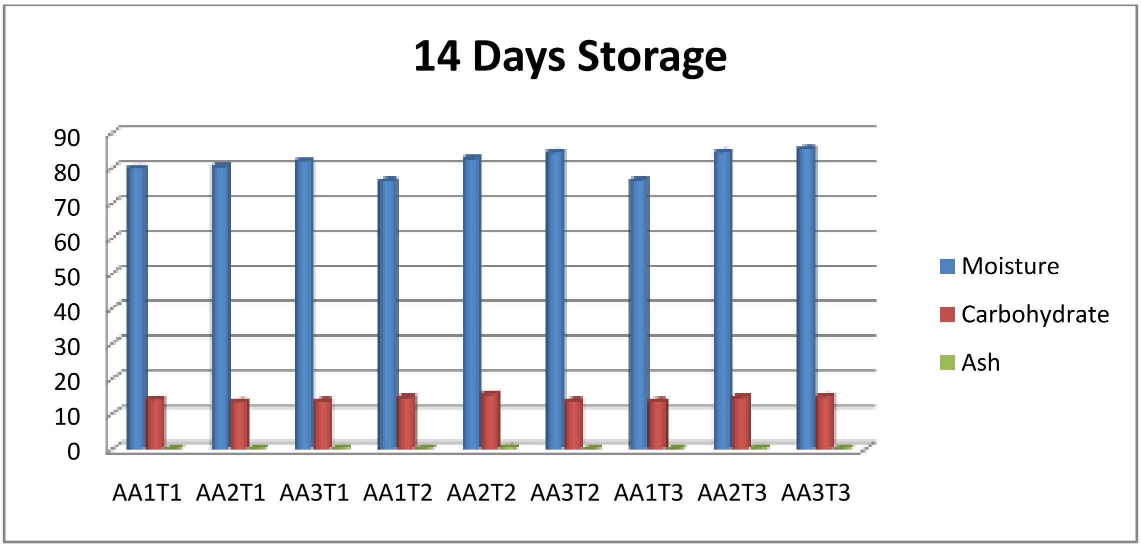



**Fig. 20 Effect of ascorbic acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at refrigerated condition (5°C)**



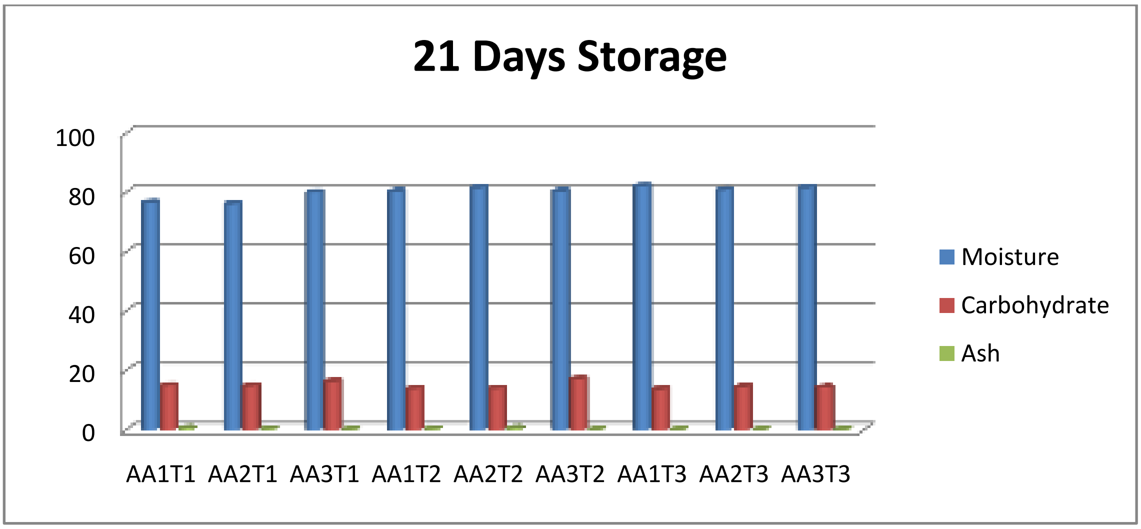



**Fig. 21** **Effect of ascorbic acid and pasteurization temperature on moisture, carbohydrate and ash content of stored sugarcane juice at ambient condition (30°C)**

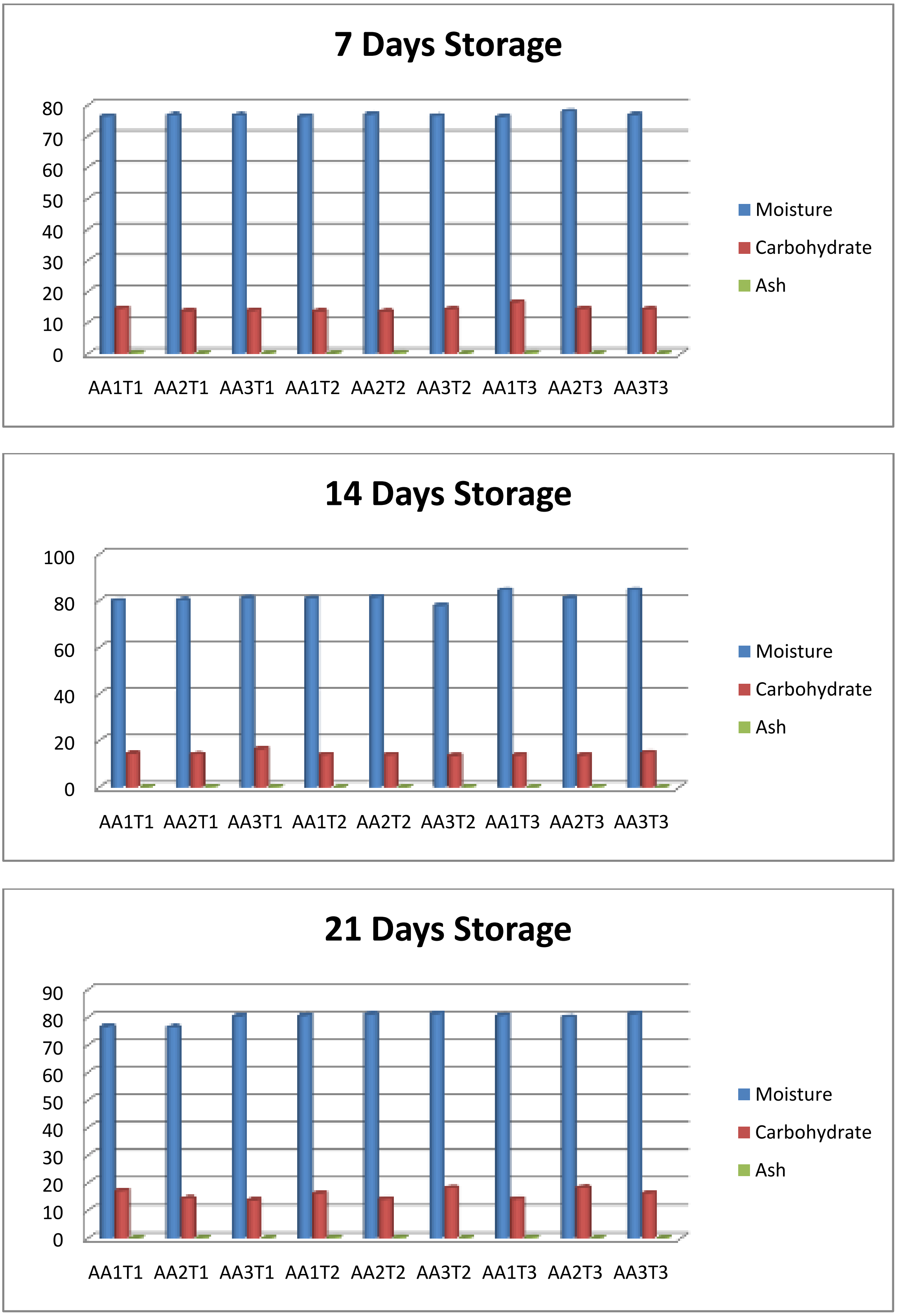
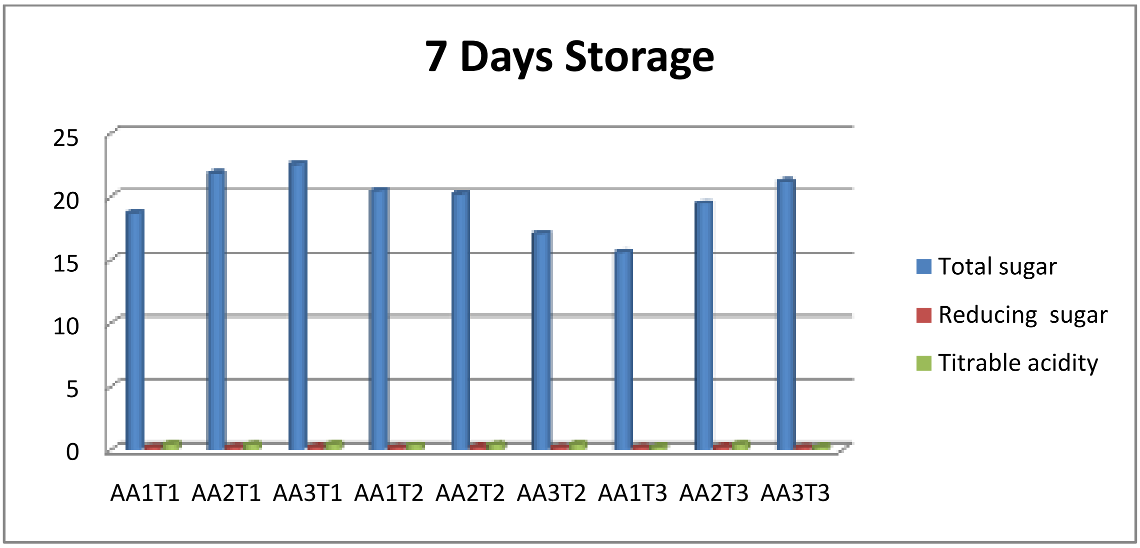
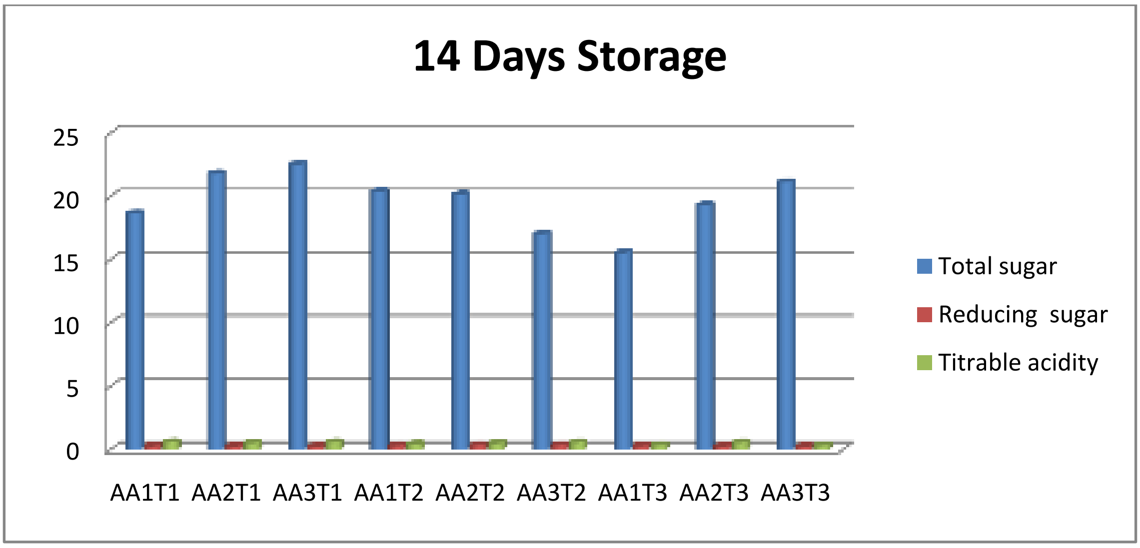


**Fig. 22 Effect of ascorbic acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at refrigerated condition (5°C)**



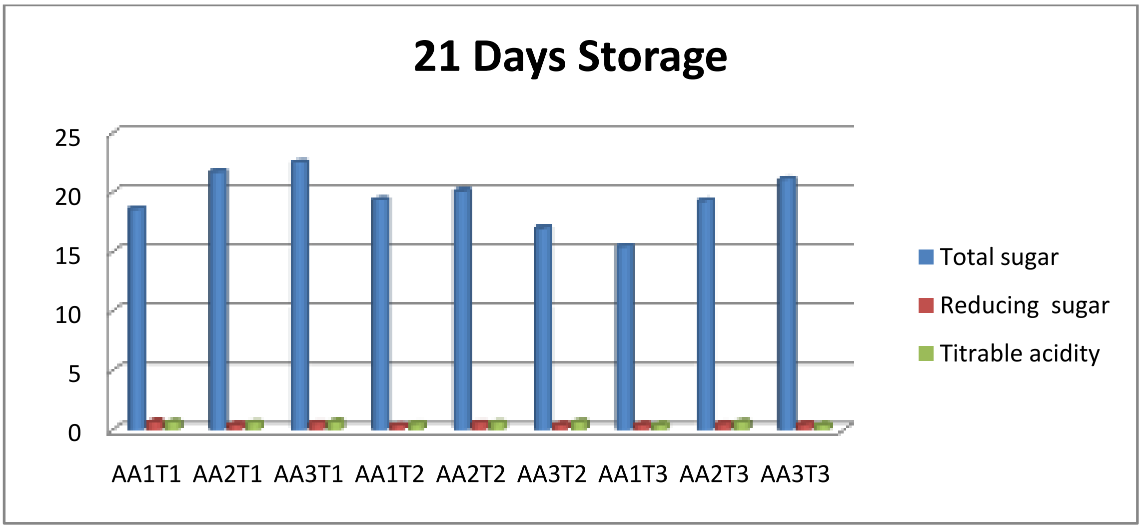
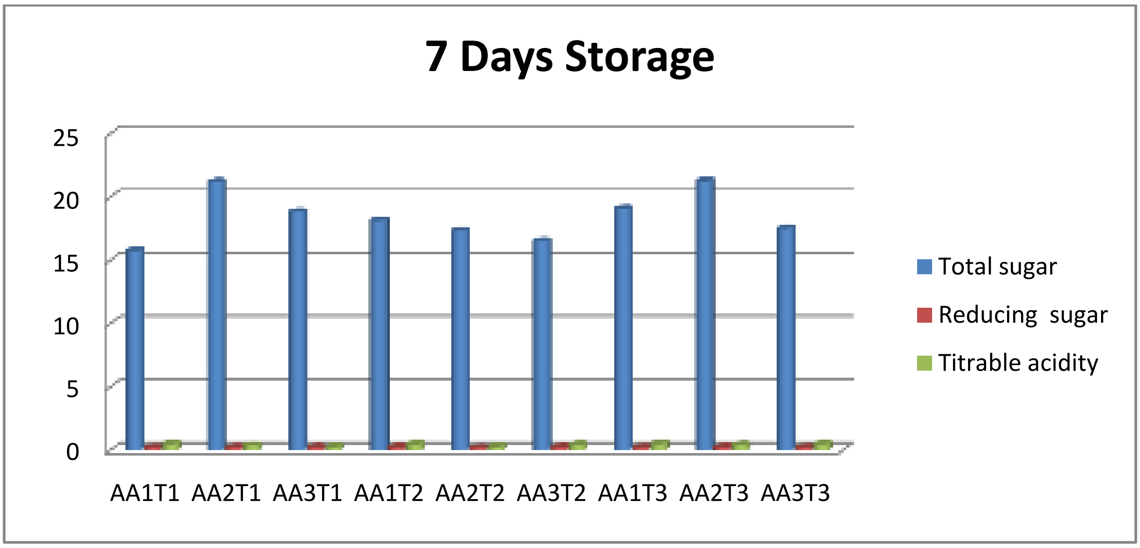
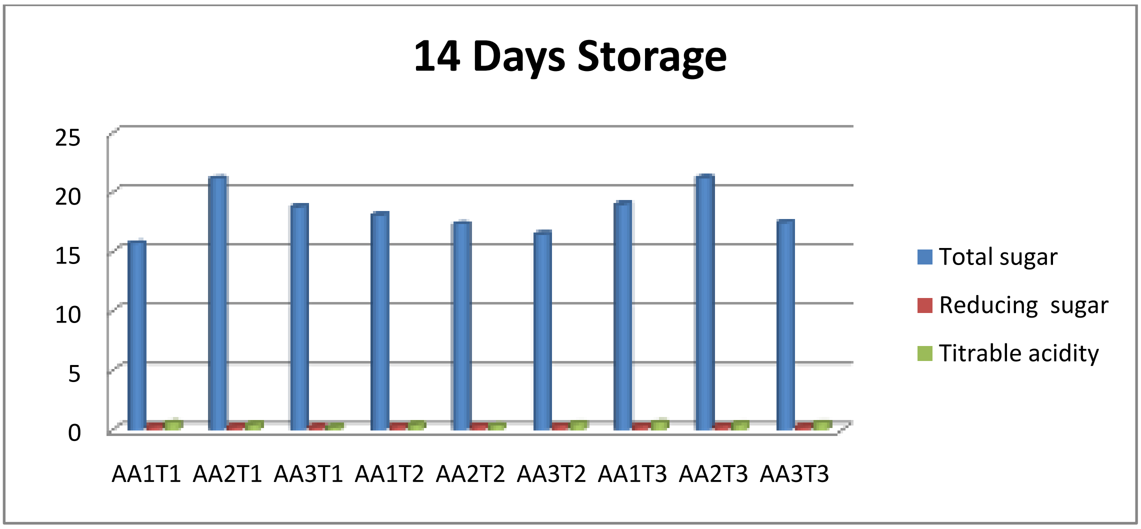



Fig. 23 **Effect of ascorbic acid and pasteurization temperature on total sugar, reducing sugar and titrable acidity of stored sugarcane juice at ambient condition (30°C)**



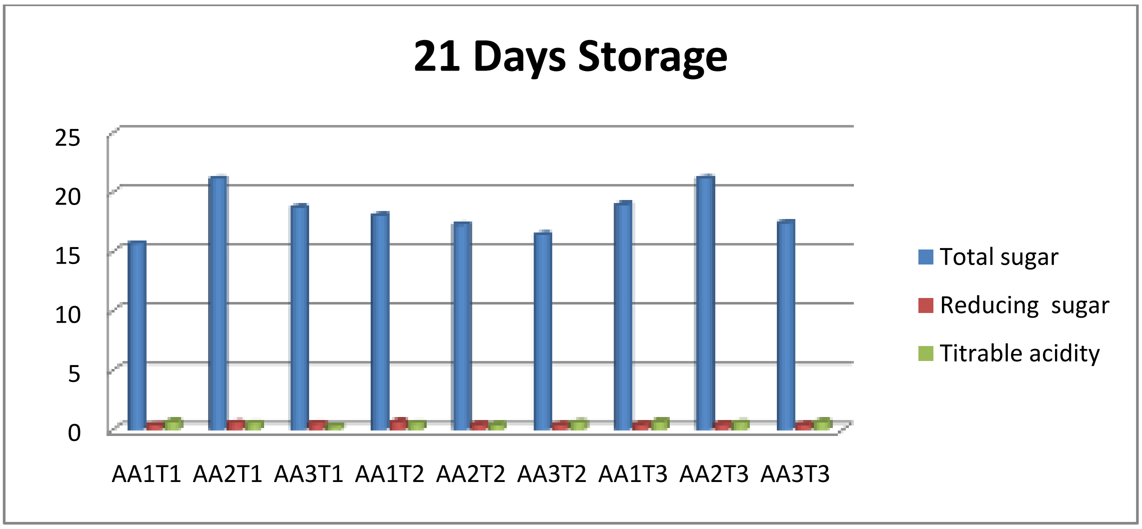
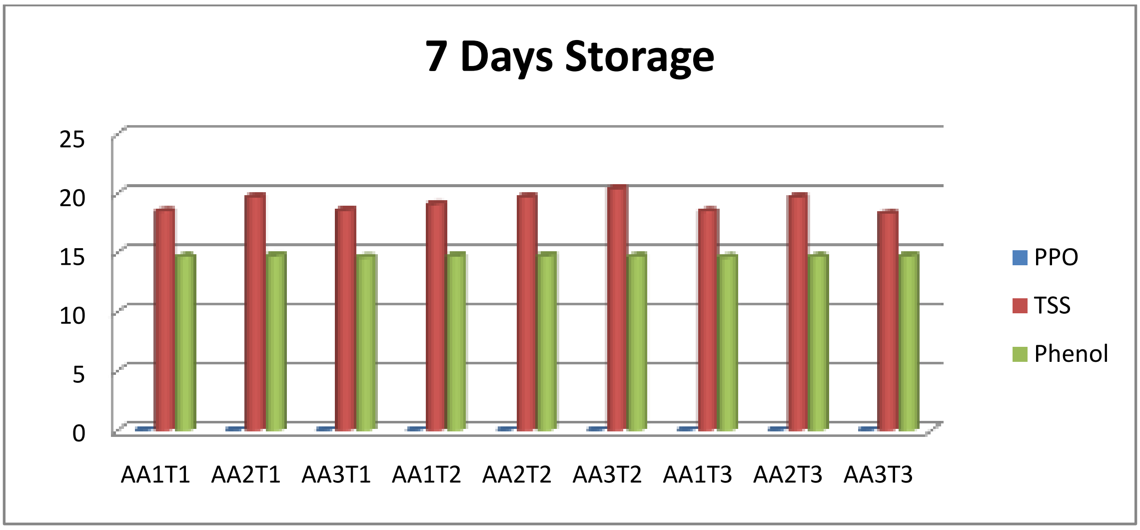
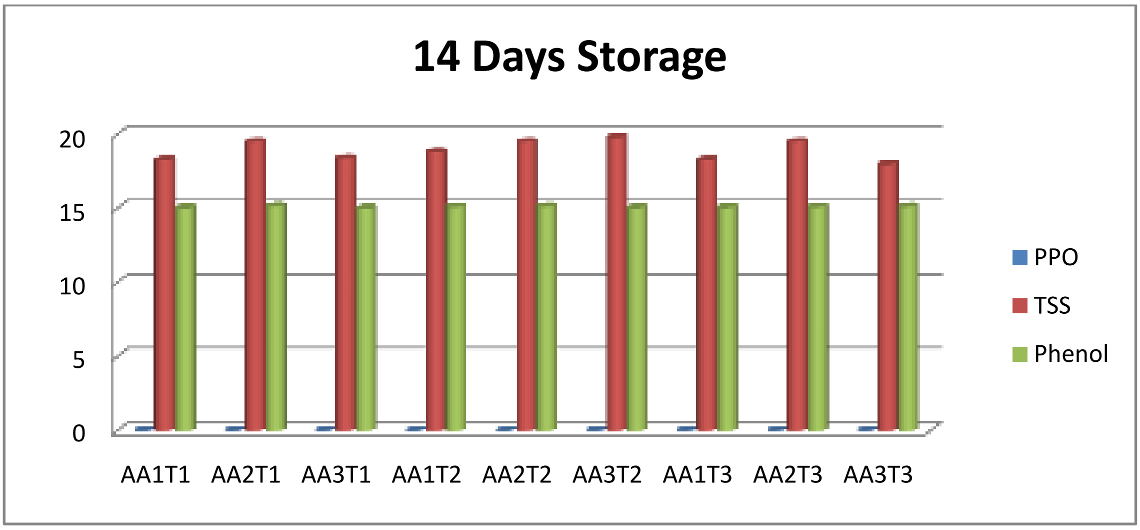



**Fig. 24** **Effect of ascorbic acid and pasteurization temperature on poly phenol oxidase (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice at refrigerated condition (5°C)**



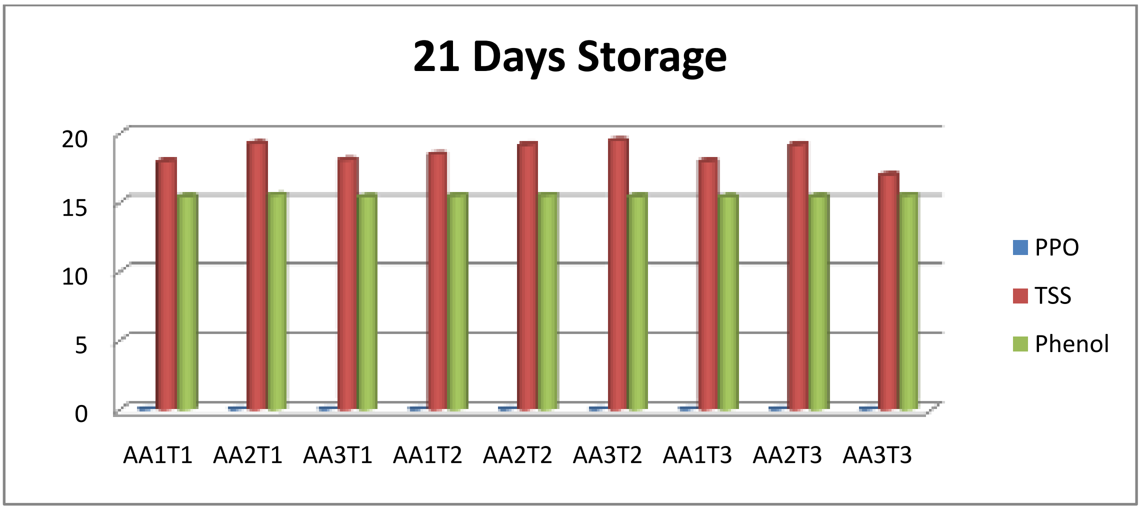
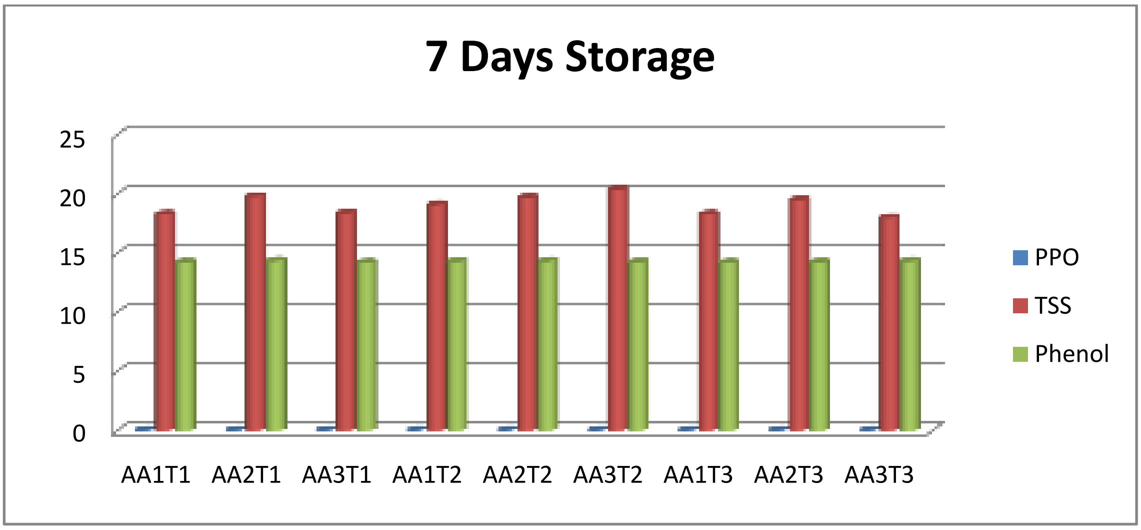
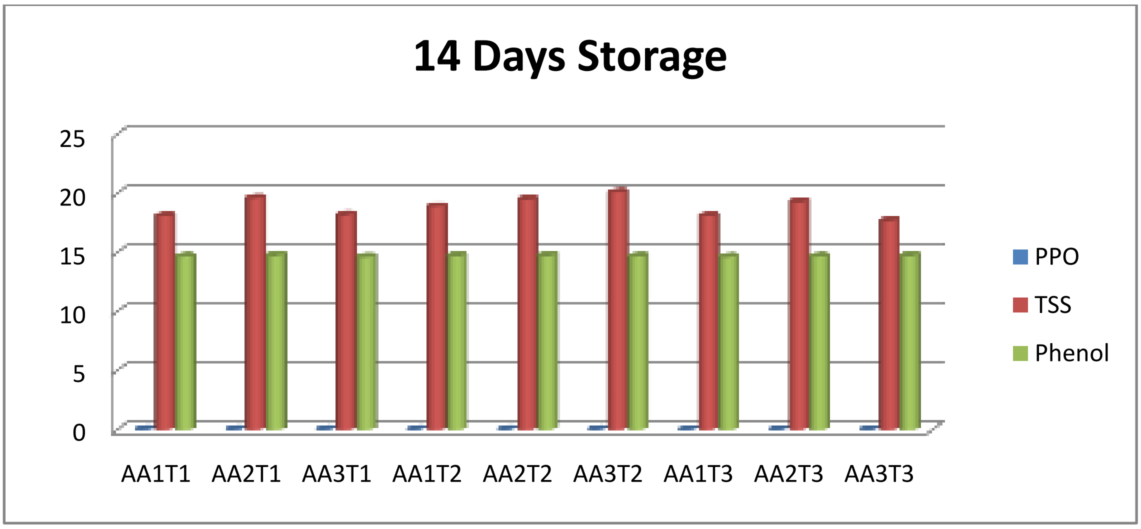



**Fig. 25** **Effect of ascorbic acid and pasteurization temperature on poly phenol oxidase (PPO), total soluble solids (TSS) and phenol content of stored sugarcane juice at ambient condition (30°C)**



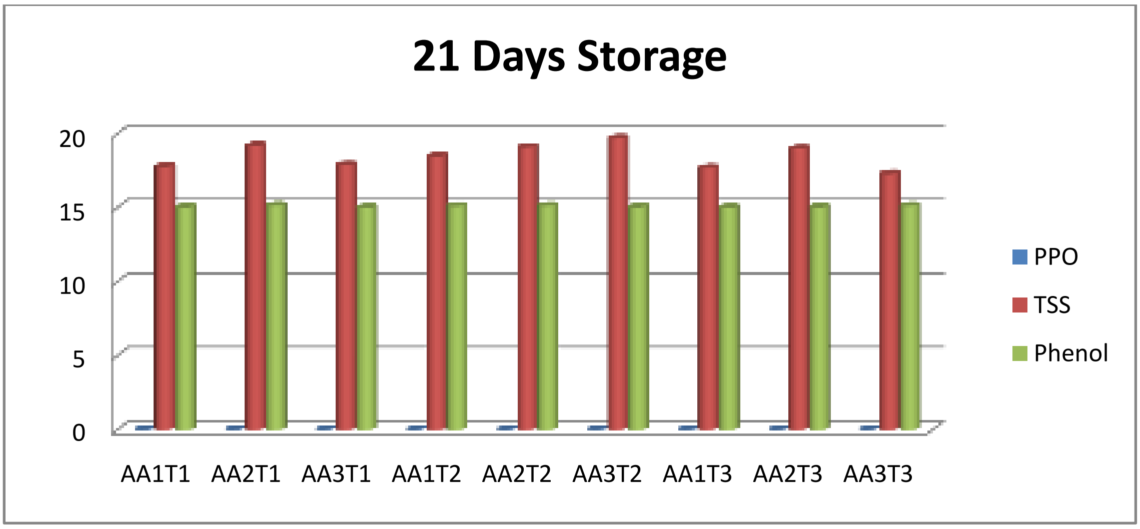



Fig. 26 **Effect of citric acid and pasteurization temperature on total plate count of stored sugarcane juice at refrigerated and ambient condition**

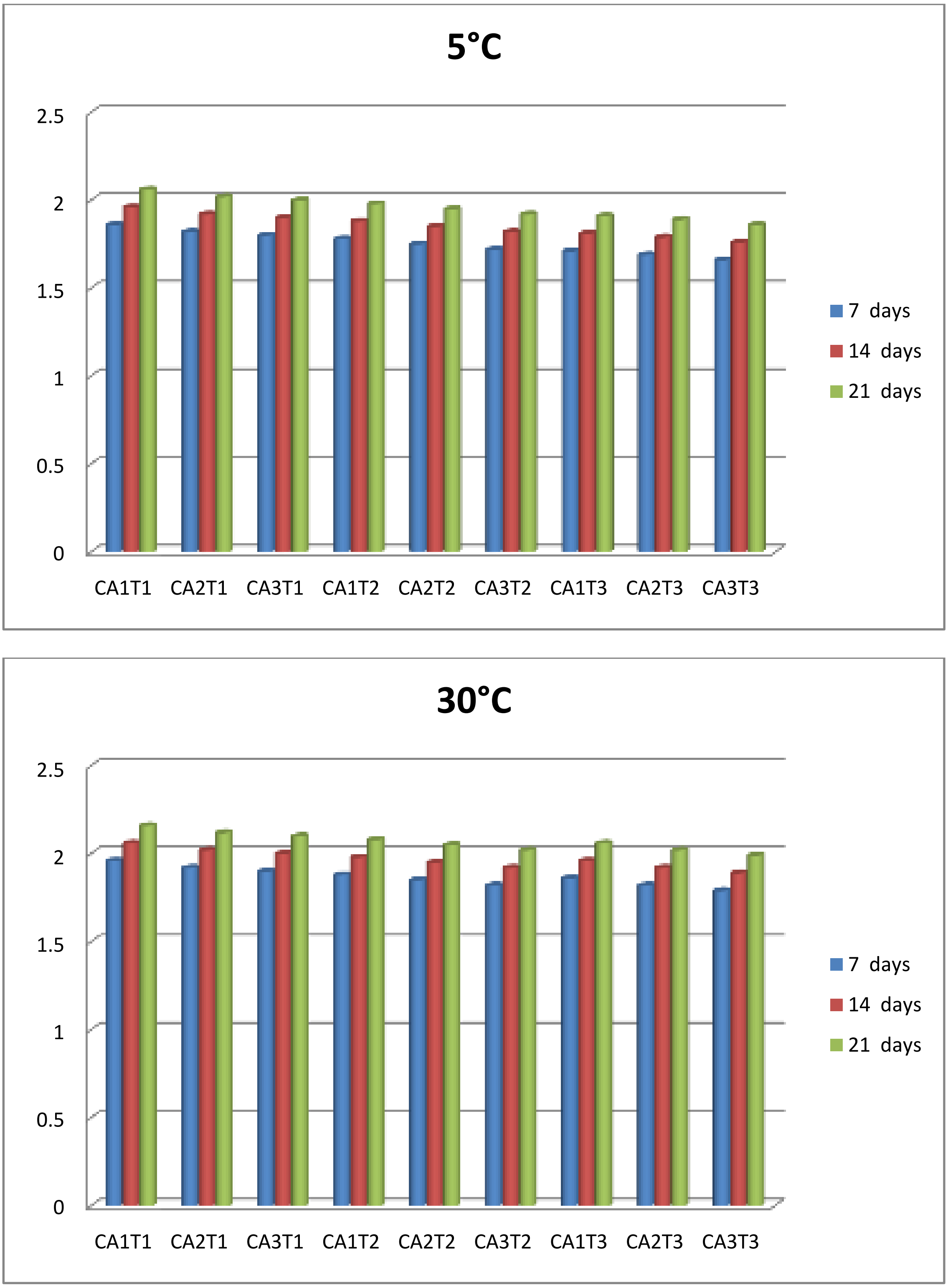
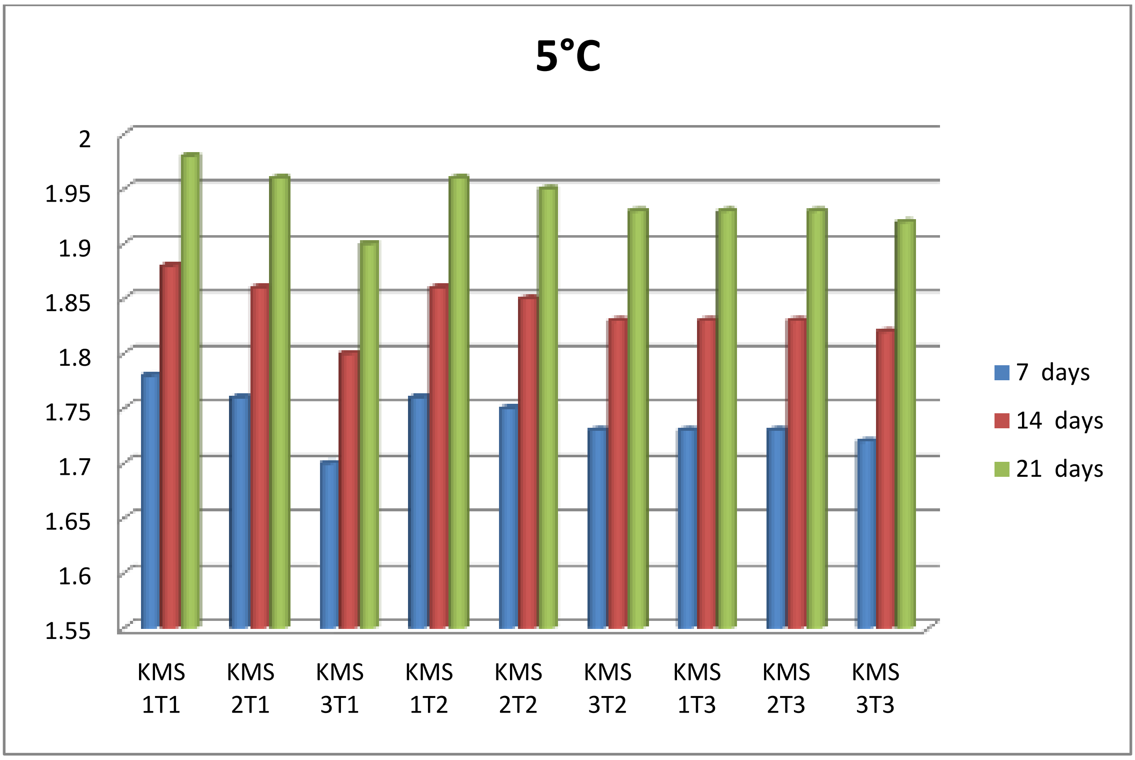


**Fig. 27 Effect of potassium metabisuphite and pasteurization temperature on total plate count of stored sugarcane juice at refrigerated and ambient condition**



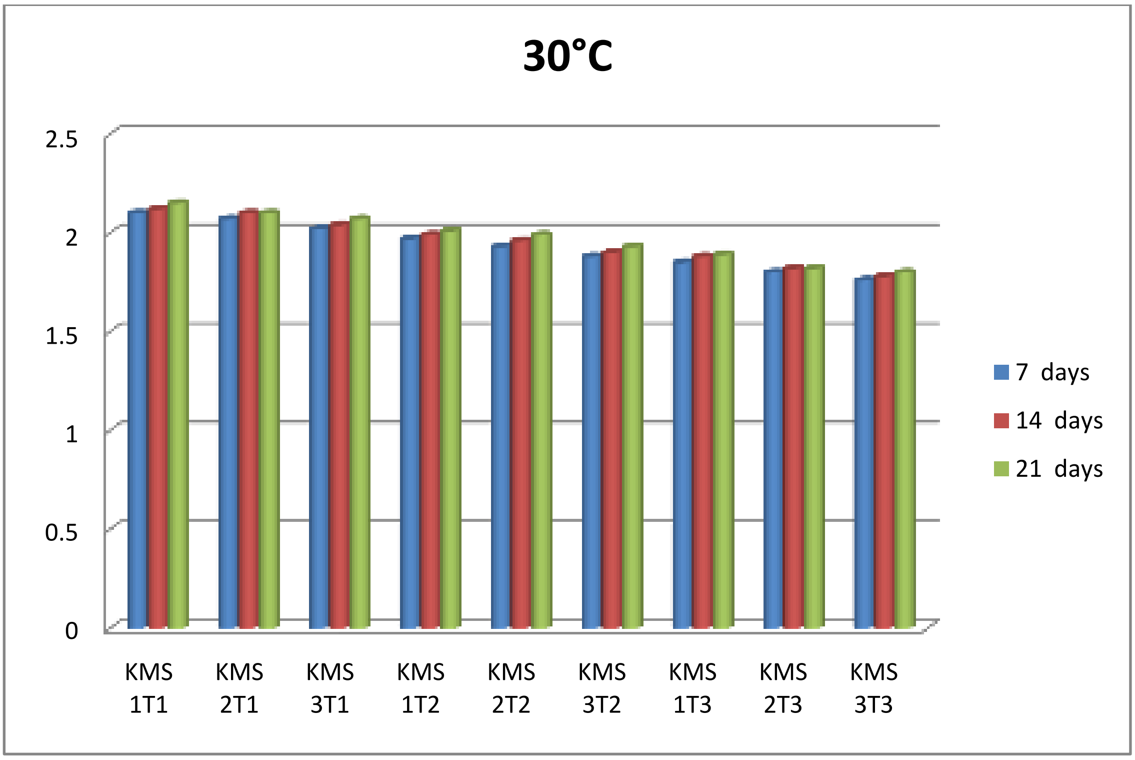



**Fig. 28 Effect of potassium sorbate and pasteurization temperature on total plate count of stored sugarcane juice at refrigerated and ambient condition**

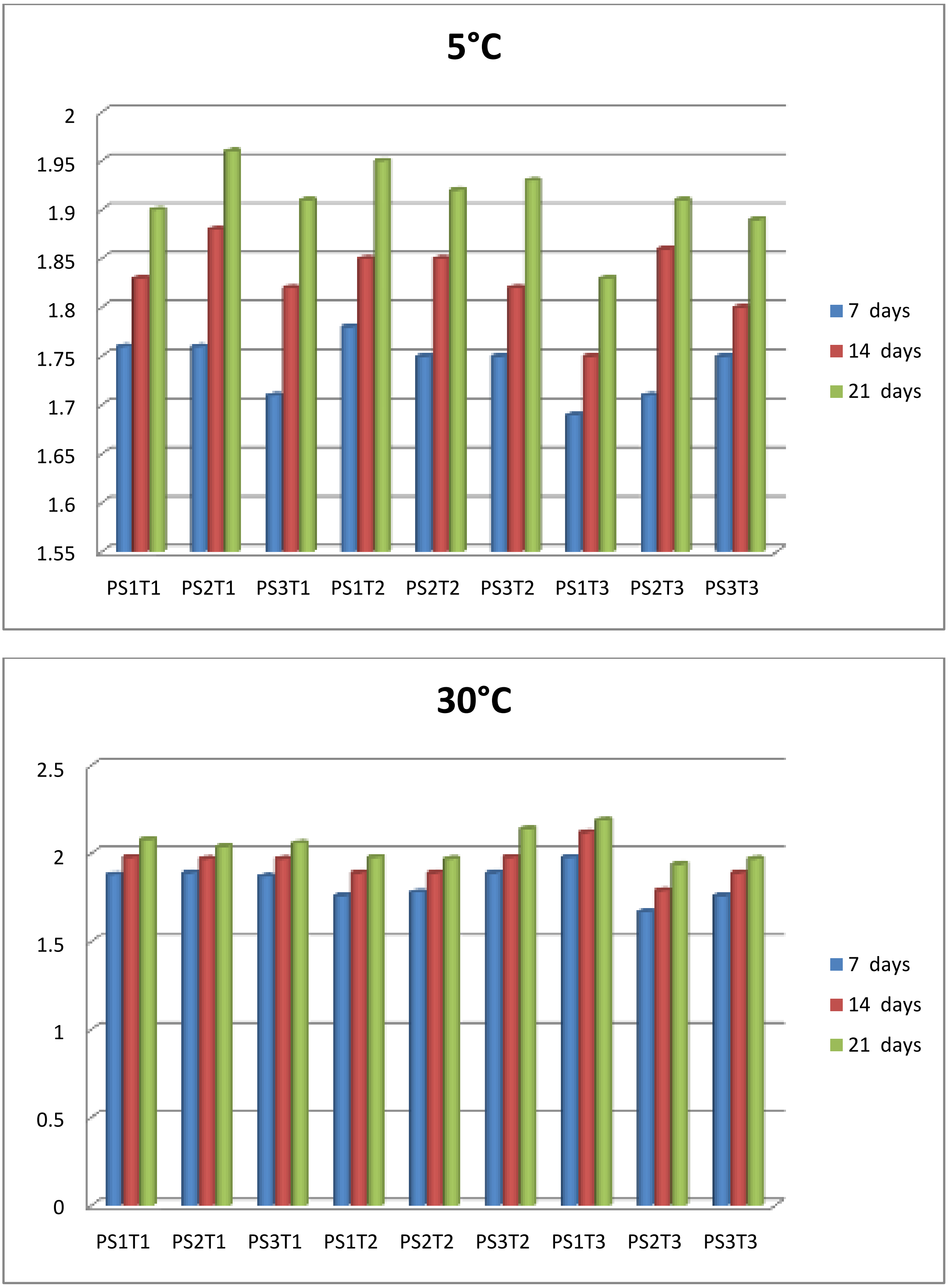


**Fig. 29 Effect of ascorbic acid and pasteurization temperature on total plate count of stored sugarcane juice at refrigerated and ambient condition**

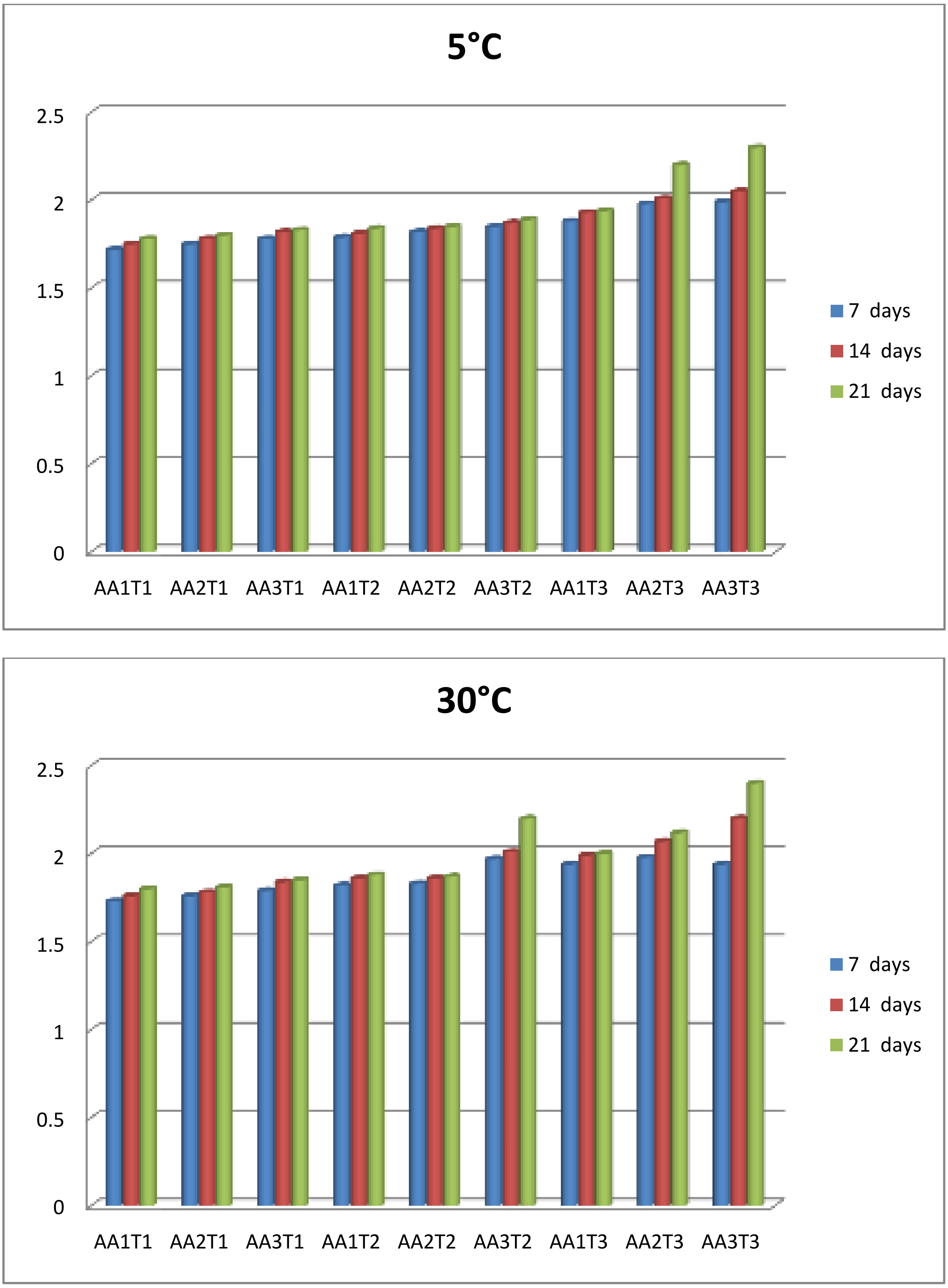


**Fig. 30 Effect of citric acid and pasteurization temperature on overall acceptability (Colour, Taste and Flavour) sensory score of stored sugarcane juice at refrigerated and ambient condition**

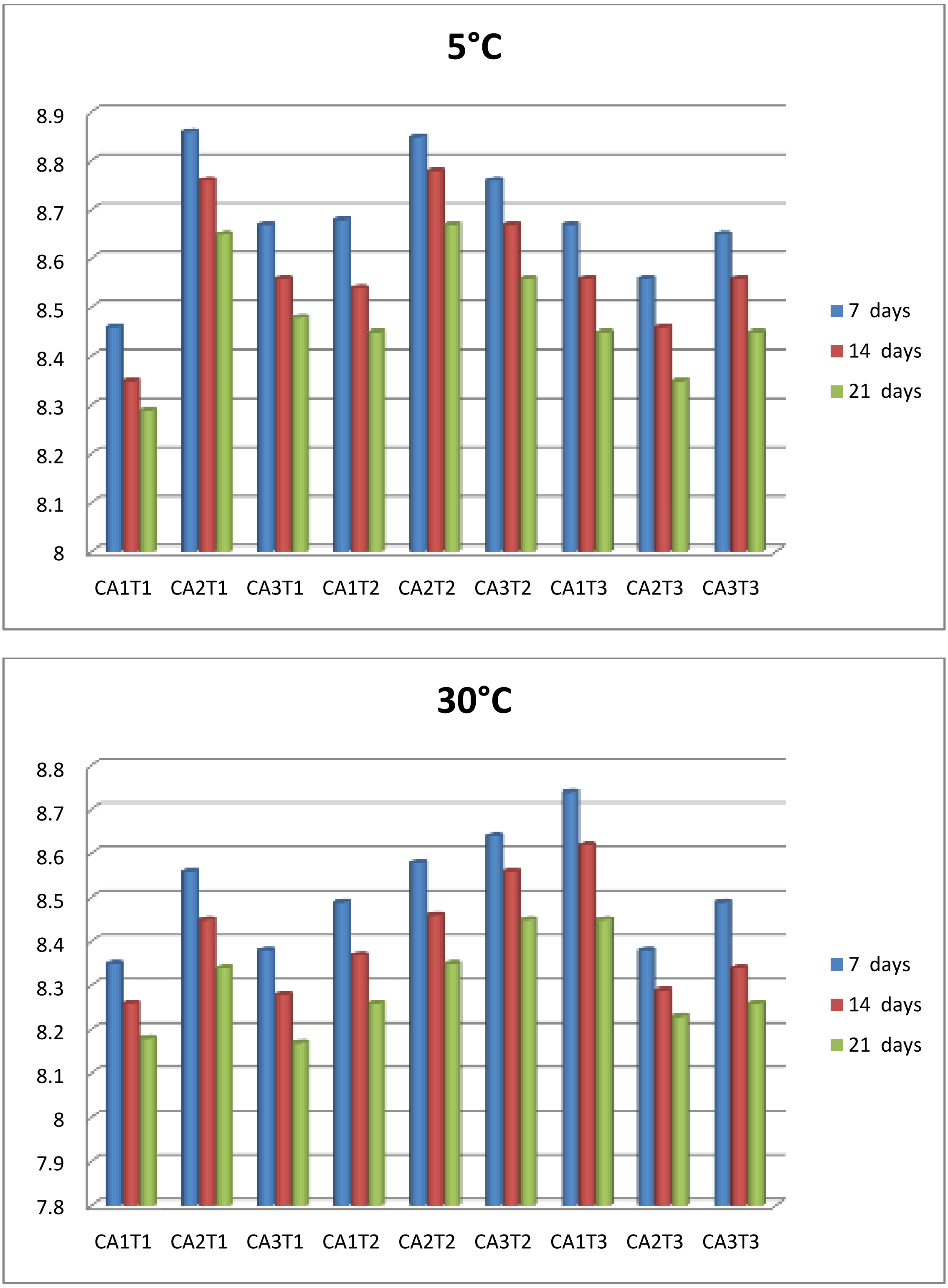
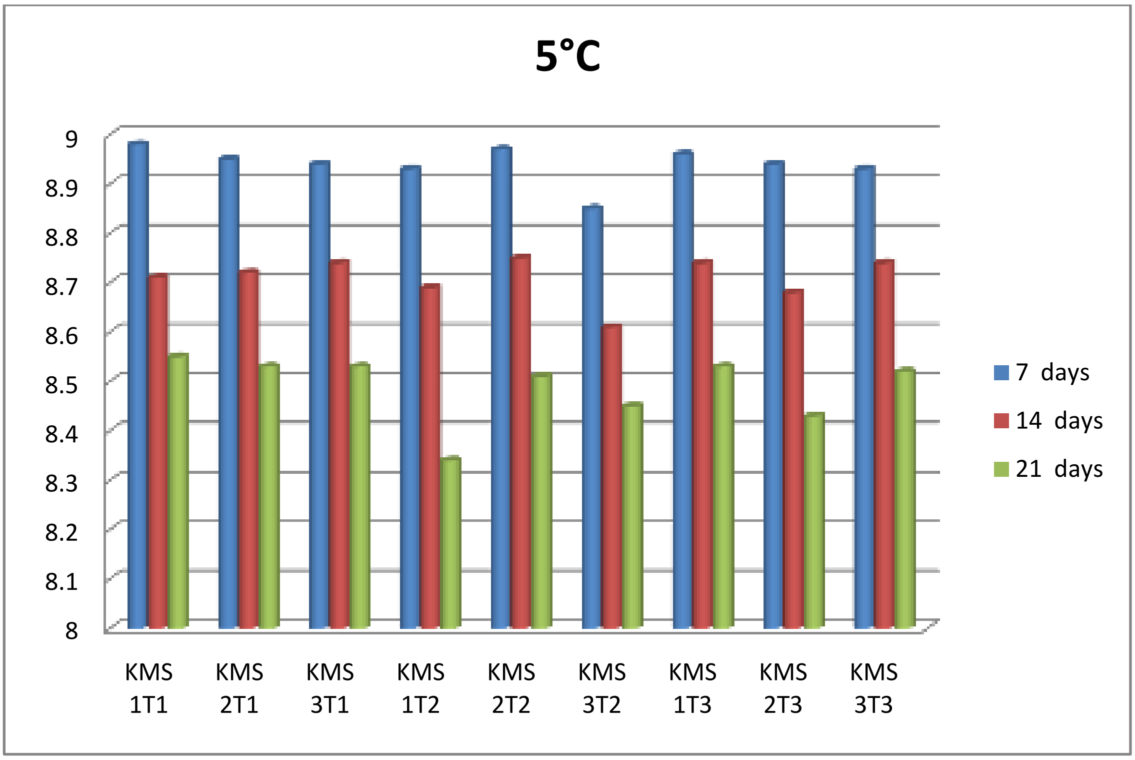


**Fig. 31** **Effect of potassium metabisulfite and pasteurization temperature on overall acceptability (Colour, Taste and Flavour) sensory score of stored sugarcane juice at refrigerated and ambient condition**



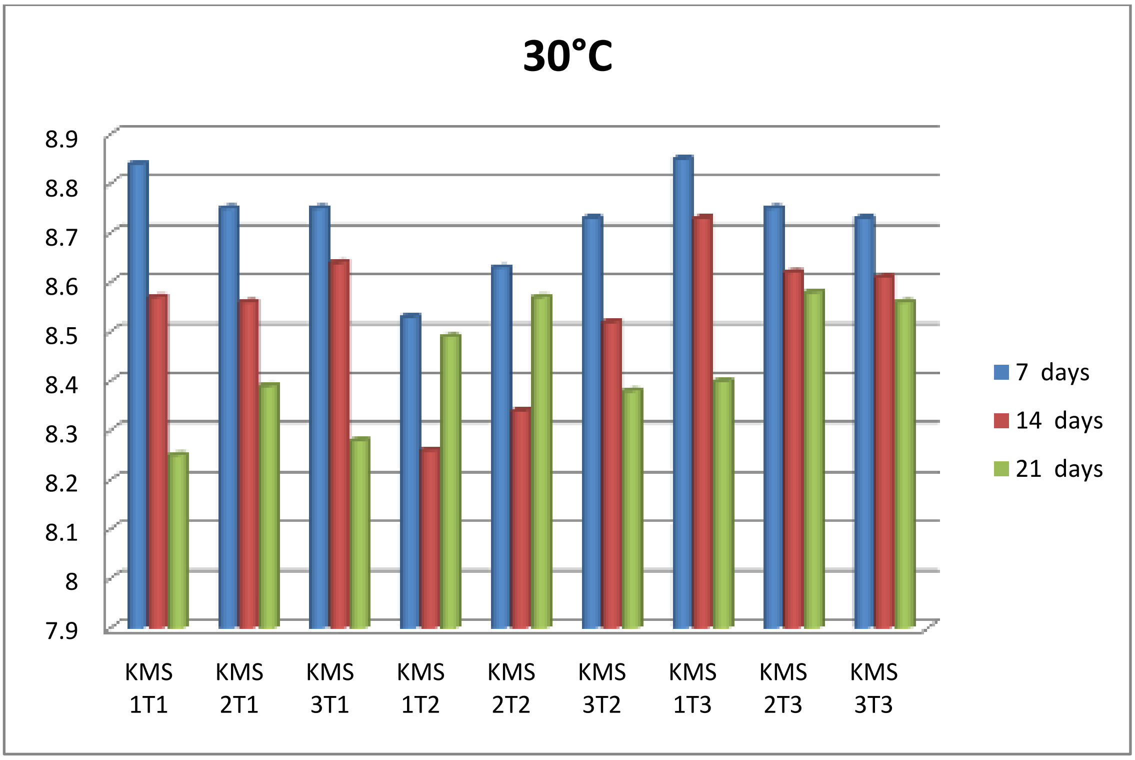
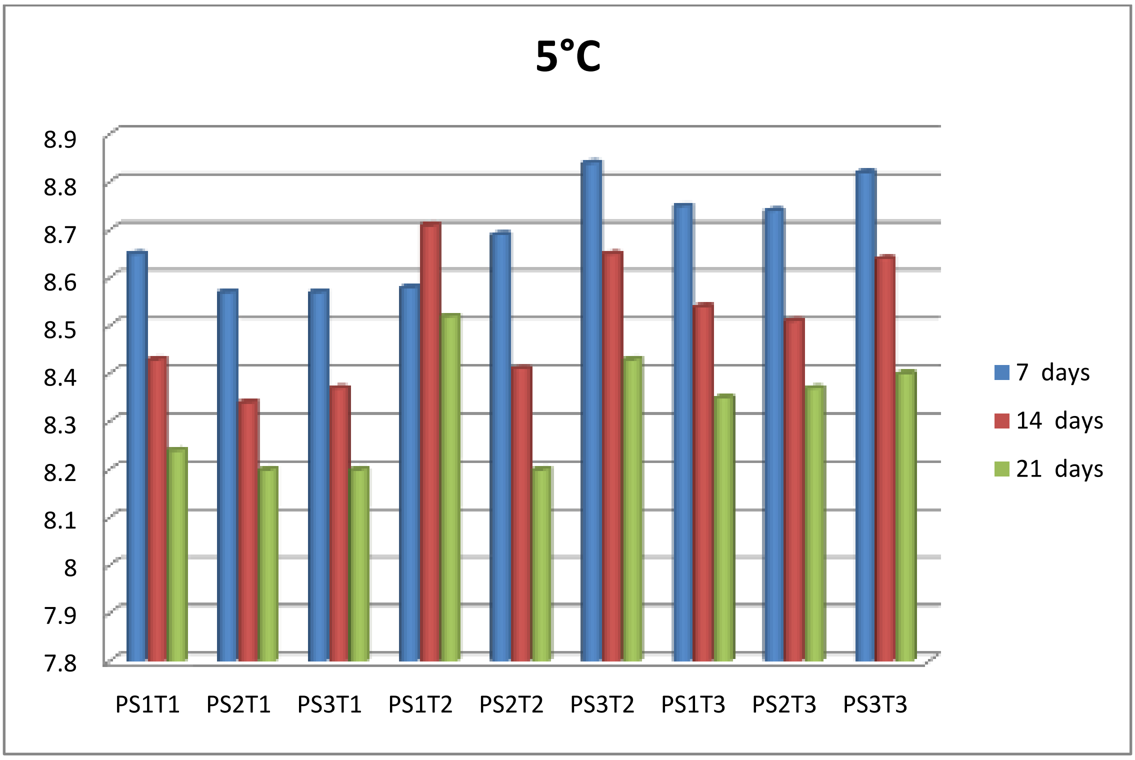



**Fig. 32** **Effect of potassium sorbate and pasteurization temperature on overall acceptability (Colour, Taste and Flavour) sensory score of stored sugarcane juice at refrigerated and ambient condition**



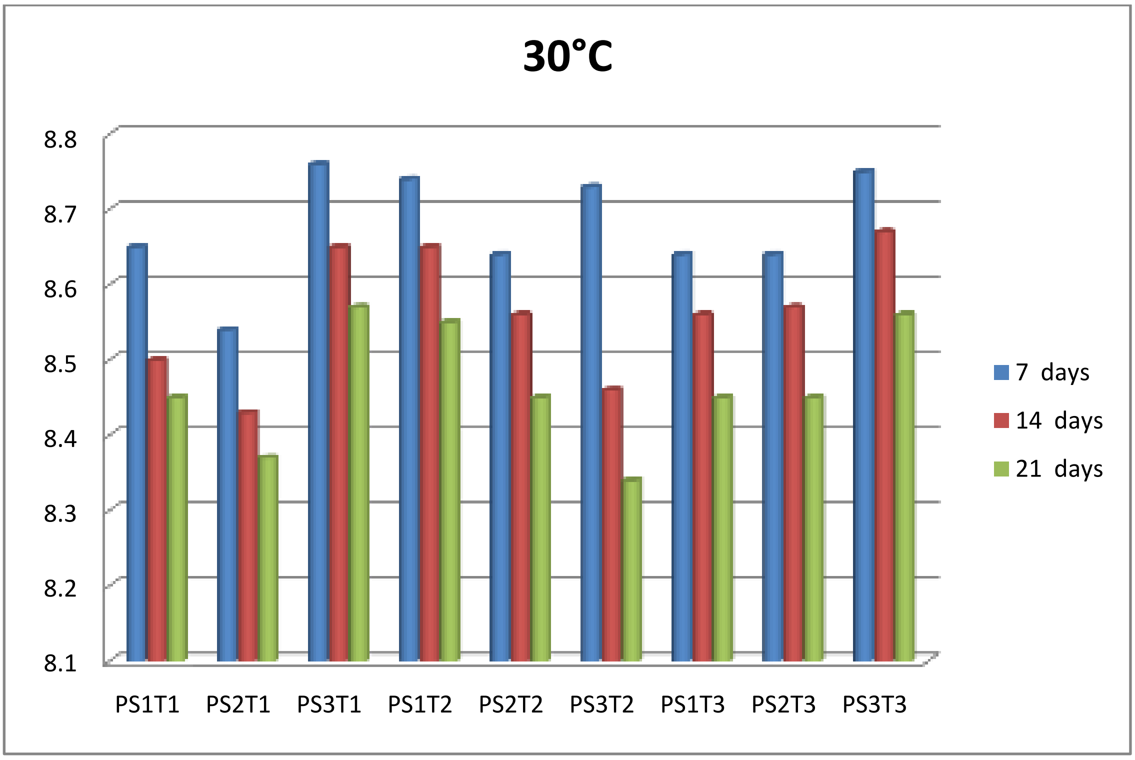
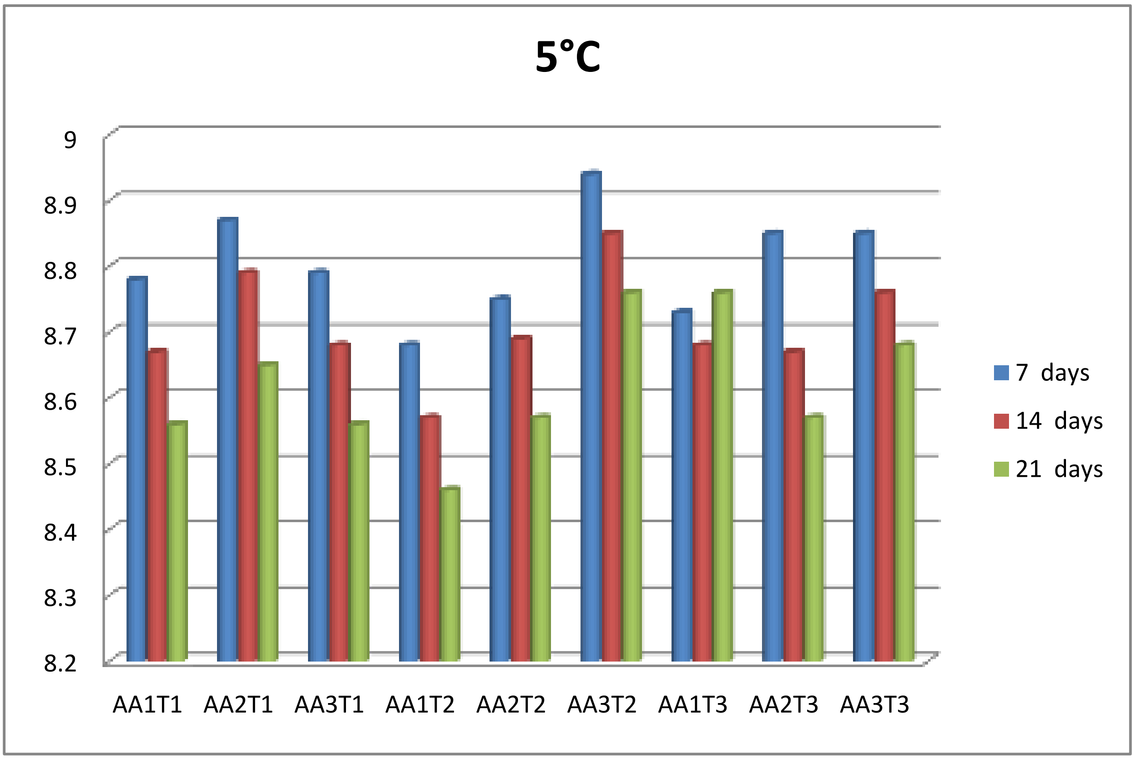
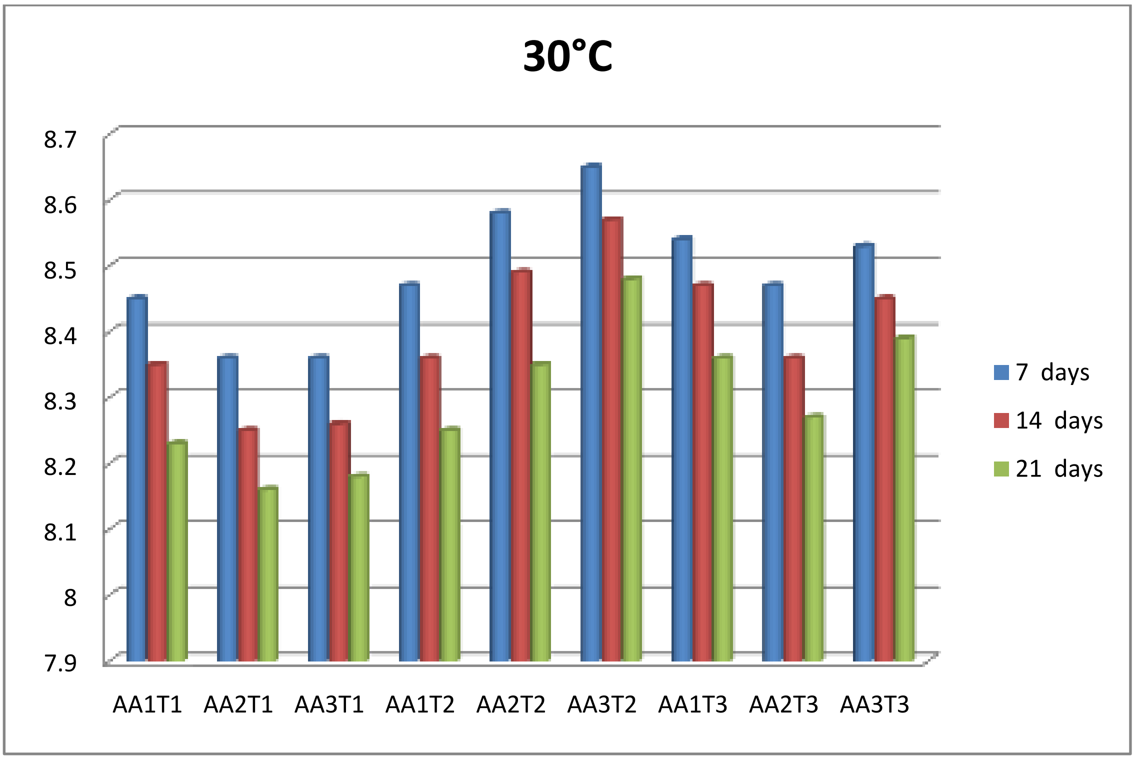



**Fig. 33** **Effect of ascorbic acid and pasteurization temperature on overall acceptability (Colour, Taste and Flavour) sensory score of stored sugarcane juice at refrigerated and ambient condition**



Effect of Citric acid, KMS, Potassium sorbate & Ascorbic acid bottled sugarcane juice stored at $5^0$ C temperature

Effect of Citric acid, KMS, Potassium sorbate & Ascorbic acid bottled sugarcane juice stored at $30^0$ C temperature

FRESH JUICE

Stored at $5^0$ C tamperature

Citric acid

Potassium metabisulphite

Potassium Sorbate

Ascorbic acid

Stored at 30$^0$ C tamperature


Citric acid

Potassium metabisulphite

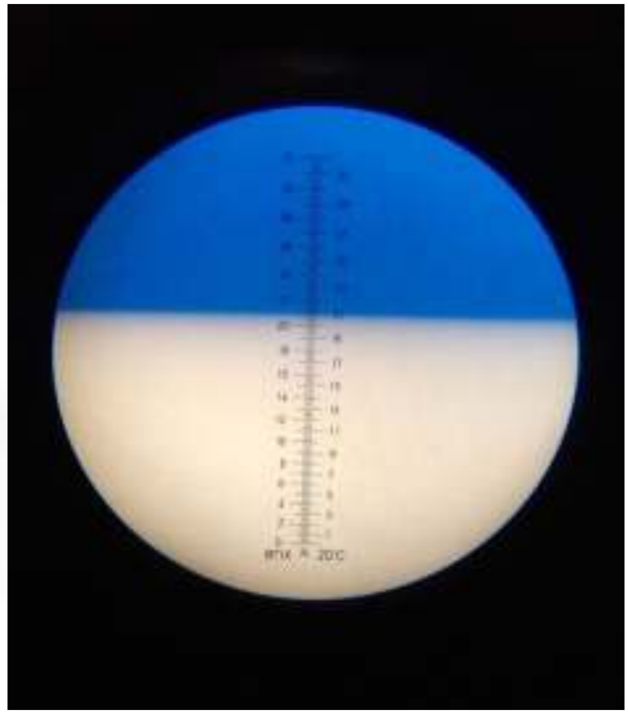
Potassium Sorbate

Ascorbic acid

Crown cap

Glass bottles

Crown capping machine

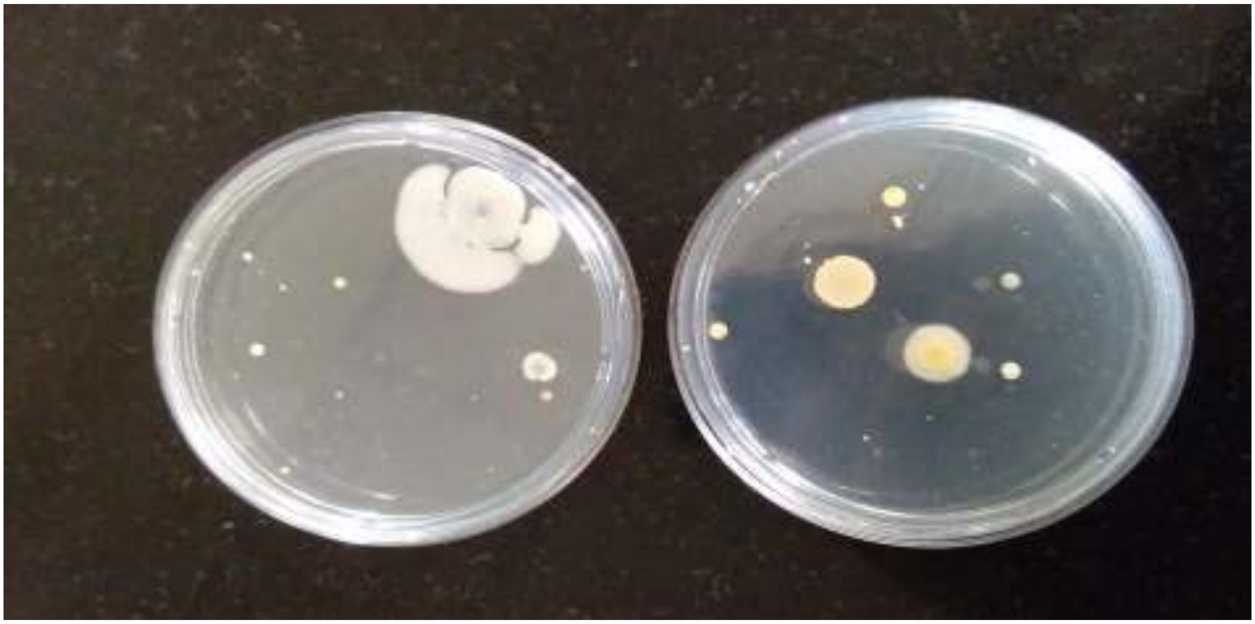


Referactometer

Referactometer reading

Tharmameter

## Microbial count



Autoclave