



## Standardization and Quality Evaluation of Sugarcane: Citrus Juice Blended Beverage

Aamer Sattar<sup>1\*</sup>, Ghulam Abbas<sup>1</sup>, Irfan Rasheed<sup>1</sup>, Syed Aftab Hussain Bukhari<sup>1</sup>, Ijaz Ahmad Minhas<sup>2</sup>

<sup>1</sup>Sugarcane Research Institute, Ayub Agriculture Research Institute, Faisalabad, Pakistan.

<sup>2</sup>National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan.

### Abstract

The extreme hot season and high prices of available beverages have compelled to prepare a beverage which should be nutritious, tasty, economical as well as nutraceutical in nature as it provides calories as well as essential vitamins. The blended juices have improved flavor, nutritive value and are comparatively economical. This study was designed to find out the best blended ratio of kinnow and sugarcane juices (20:80, 40:60, 60:40 and 80:20) with better acceptability. The samples were analyzed for TSS, acidity, pH, reducing and non-reducing sugars, ascorbic acid contents, cloud stability and sensory evaluation with storage intervals of 0, 30, 60 and 90 days at ambient storage conditions. The results revealed that total soluble solids, acidity and reducing sugars increased while pH and non-reducing sugars decreased significantly during storage up 90 days. A decreasing trend in ascorbic acid content was observed and decline in cloud stability occurred with the passage of time during storage. However, subjective tests in terms of sensory evaluation, the beverages with higher kinnow juice contents i.e. kinnow: sugarcane (60:40 & 80:20) were ranked best. The pasteurized storage during 60 days was found quite safe, hence such beverages are recommended for industrial / commercial basis for the utilization of masses.

**Keywords:** sugarcane juice, citrus juice, physicochemical, sensory evaluation

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\*Corresponding Author, e-mail: [aamer\\_sattar@yahoo.com](mailto:aamer_sattar@yahoo.com)

### 1. Introduction

Human health has considered an unprecedented importance in recent times. Public interest has increased in nutrition, fitness and healthy life. The growing interest in new natural juice beverages with exceptional taste and health promoting properties has led to the development of new products. The global market of such related food products is estimated at least US\$ 33 billion (Hilliam, 2000).

Sugarcane juice is highly nutritious, thirst quenching and delicious drink, commonly used in both urban and rural areas of Pakistan. Its handling, preparation and keeping practices need special care and attention to maintain its quality (Nonga *et al.*, 2014). Sellers of sugarcane juice also add lemon, ginger and mint for enhancing the taste. Taste of citrus not only has pleasant effects on tongue but also enhances mood. Similarly fresh orange juice is also a popular beverage among the masses. Both the juices are available at comparatively low price due to local production and are nutritious also. Moreover, the blending of different fruit juices offers a wide scope in developing new products. It is very difficult and challenging task to develop unfermented beverage than semi or fully fermented beverages (Wang *et al.*, 2000). A major challenge to develop a nutraceutical beverage is to preserve its nutrients and to make with acceptable sensory characteristics (Marchio, 1995) as preservation of natural juices need special care to maintain its keeping

quality. The addition of ascorbic acid containing natural juice in sugarcane juice lowers the pH of juice blend which gives preservative effect by inhibiting the microbial growth during storage (Sangeeta *et al.*, 2013). The soft drinks contain some polysaccharides in the form of hydrocolloids to enhance the mouth feel and to capture the CO<sub>2</sub> bubbles (Descoinset *et al.* 2006). The quality of the beverage depends upon sensory attributes and chemical tests (Duffy *et al.* 2010). Keeping in view the wide range of above mentioned properties, the present study was therefore, designed to prepare a nutritious formulation from natural and indigenous resources by various blend ratios of kinnow and sugarcane juices to have a ready to drink beverage with good taste, acceptability and keeping quality up to 90 days at ambient temperature conditions (25±5C°).

## 2. Materials and Methods:

This study was conducted at Sugarcane Technology Laboratory, Sugarcane Research Institute, AARI, Faisalabad, Pakistan during the year 2013. Sugarcane and kinnow fruits were washed properly and juices were extracted separately by using conventional methods. The extracted juices were blended according to treatments. The detail of the blending ratios of both juices was as under;

Treatments	Blend Ratio	
	Kinnow Juice	Sugarcane Juice
T <sub>1</sub>	20	80
T <sub>2</sub>	40	60
T <sub>3</sub>	60	40
T <sub>4</sub>	80	20

The blended juice samples were prepared accordingly in three replications and filled in 250 mL glass bottles, crown corked and pasteurized at 95°C for 8 minutes. The research study was carried out for the period of three months under ambient temperature conditions. During this period beverages were subjected to various tests after one month interval. The detail of analytical protocols followed for physico-chemical properties analyses are mentioned below;

### 2.1. Physico – Chemical Analysis:

The prepared / blended kinnow and sugarcane juice samples were subjected to physico-chemical analysis regarding total soluble solids, titratable acidity, pH value, reducing & non-reducing sugars, ascorbic acid content and cloud stability at different storage intervals of 0, 30, 60 and 90 days. International Standard Test Methods described in AOAC, 2006 were followed.

### 2.2. Sensory Evaluation:

The samples were subjected to sensory evaluation by sensory evaluation panelists. The sensory evaluation data for color, flavor and taste was collected in five replicates on 09 points hedonic scale for overall acceptability as described by Lee *et al.* (2003).

### 2.3. Statistical Analysis:

The collected data were subjected to statistical analysis by following CRD Factorial design according to Steel *et al.* (1997).

### 3. Results and Discussion

#### 3.1. Total Soluble Solids

The results revealed that total soluble solids increased throughout the storage period (Fig-1) and predicted highly significant results for storage and treatments as shown in Table-2. Means of TSS regarding all the treatments under study ranged from (11.43-14.63 %). Its contents were at a higher range in treatments where sugarcane juice blend ratio was more (60:40 & 80:20). Mean maximum TSS content (14.63 %) was observed in case of treatment T1 where 20:80 blend ratio of kinnow and sugarcane juice was present respectively. The lowest mean value of 11.43 % was seen in treatment T4 where 80:20 blend ratio of kinnow and sugarcane was used. The same increasing trend of total soluble solid was observed by Balaswamy *et al.* (2011), during storage period in different types of non-carbonated beverages. The increase in total soluble solids may be due to formation of water soluble pectic substances from protopectin and conversion of cellulosic substances to soluble carbohydrates during storage and pasteurization.

#### 3.2. Titratable Acidity

Acidity in terms of percent citric acid increased gradually in all the treatments throughout the storage period (Fig-3). The results remained highly significant for treatments and non significant for storage as shown in Table-2. Mean maximum acidity (0.58 %) was observed in treatment T4 (80:20 blend of kinnow and sugarcane juices). As the content of kinow juice decreased in blends, the decreasing trend in acidity was observed. The overall acidity ranged from (0.23-0.58 %) in all the treatments. This increase in acidity might be due to degradation or oxidation of sugars and breakdown of protpection to pectic acids. The same trend of acidity was observed in different types of low alcoholic blended beverages by Sahota *et al.* (2010).

#### 3.3. pH Value

The results of present study regarding pH of kinnow and sugarcane juice blends depicted the changing pattern of this parameter, i.e. inverse relation of acidity with pH of values of blends was seen (Fig-2). As acidity increased the pH value decreased accordingly. These results were in line as described by Sangeeta *et al.* (2013). The pH values affected by various treatments during storage are given in Table-2. Significantly increasing trend of pH was observed with the increase of sugarcane juice among the treatments / blends of beverage under study. pH value ranged from (3.23-3.59) in different treatments. Highest mean value of pH (3.59) was observed in the treatment where 20:80 ratio of kinnow and sugarcane juice was used. The pH value of all the blends decreased with the passage of time during a storage period of 90 days maximum. These results are also in accordance with those reported by El-Faki and Eisa, (2010) who found that pH of various carbonated beverages showed decreasing trend during storage at ambient temperature.

**Table-1: Effect of Treatments and Storage on Sensory Evaluation and Cloud stability of Various kinnow and Sugarcane Juice Blends**

Treatments	Blend Ratio		Sensory Evaluation			Cloud Stability (cm)
	Kinnow	Sugarcane	Color	Flavor	Taste	
T1	20	80	4.65 d	4.45 d	5.70 c	8.10 c
T2	40	60	6.10 c	4.90 c	6.15 b	11.25 bc
T3	60	40	6.60 b	5.75 b	6.35 ab	13.78 ab
T4	80	20	6.85 a	6.40 a	6.65 a	15.98 a
Analysis Of Variance	S.O.V.		-	-	-	-
	Storage		1.426	3.51	1.842	107.6
	Treatments		3.873	3.030	0.636	45.895
	Error		0.016	0.014	0.014	5.155

**Table-2: Effect of Treatments and Storage on Chemical Properties of Various kinnow and Sugarcane Juice Blends.**

Treatments	Blend Ratio		TSS (%)	Acidity (%)	pH	Reducing Sugars (%)	Non-Reducing Sugars (%)	Ascorbic Acid (mg/100ml)
	Kinnow	Sugarcane						
T1	20	80	14.63 a	0.23 d	3.59 a	1.20 a	11.98 a	6.40 d
T2	40	60	13.50 b	0.34 c	3.41 b	1.08 b	10.88 b	10.63 c
T3	60	40	12.60 c	0.50 b	3.34 c	0.99 c	9.85 c	15.65 b
T4	80	20	11.43 d	0.58 a	3.23 d	0.90 d	9.12 d	23.05 a
Analysis Of Variance	S.O.V.		-	-	-	-	-	-
	Storage		0.5757	0.00033	0.033	0.00733	0.0536	0.599
	Treatments		7.399	0.098	0.091	0.06833	6.231	205.009
	Error		0.002	0.001	0.00022	0.00033	0.001	0.315

#### 3.4. Reducing sugars:

The results of reducing sugars analysis revealed that this attribute increased gradually during storage period (Fig-5). The statistical analysis gave highly significant results both for treatments and storage as shown in Table-2. The increase in reducing sugars may be attributed to inversion of sucrose under acidic environment. Similar results were found by Majumdar *et al.* (2011) who noticed an increase of 2.13 to 70 % during six months of storage of bottle gourd-basil leaves juice. The comparison of treatment means showed that reducing sugar of blends under study ranged from (0.90-1.20 %). The mean maximum content (1.20 %) of reducing sugar was recorded in the treatment T1 (20:80 ratio of kinnow and sugarcane juice). The other treatments showed comparatively lower content of this attribute. The minimum content (0.90 %) was analyzed in treatment T4 (80:20 blend) where quantity of sugarcane juice was minimum among all the treatments.

#### 3.5. Non-Reducing Sugars

As far as the non-reducing sugars are concerned, the results revealed that non-reducing sugars contents decreased during storage (Fig-6), the statistical analysis gives highly significant results both for treatments and storage, given in Table-2. The decrease in non-reducing sugars may be inferred as a consequence of inversion on long storage as well as on temperature. The findings of this study are supported by Singh *et al.* (2007) that with non-reducing sugars decreased with the increase in storage time. The results are also in line with the findings of Chowdhury *et al.* (2008) who studied the six months storage effects on the shelf life of mixed juice and found significant decrease in non-reducing sugars due to break down of sugars with the reaction of acids. The comparison of treatment means showed that non-reducing sugars of the prepared blends ranged from (9.12-11.98 %). The lowest content of (9.12 %) was recorded in the treatment T4 (80:20 blend of kinnow and sugarcane juice). As the sugarcane juice content increased the attribute was also increased to (11.98 %) of mean maximum level i.e. T1 (20:80 blend).

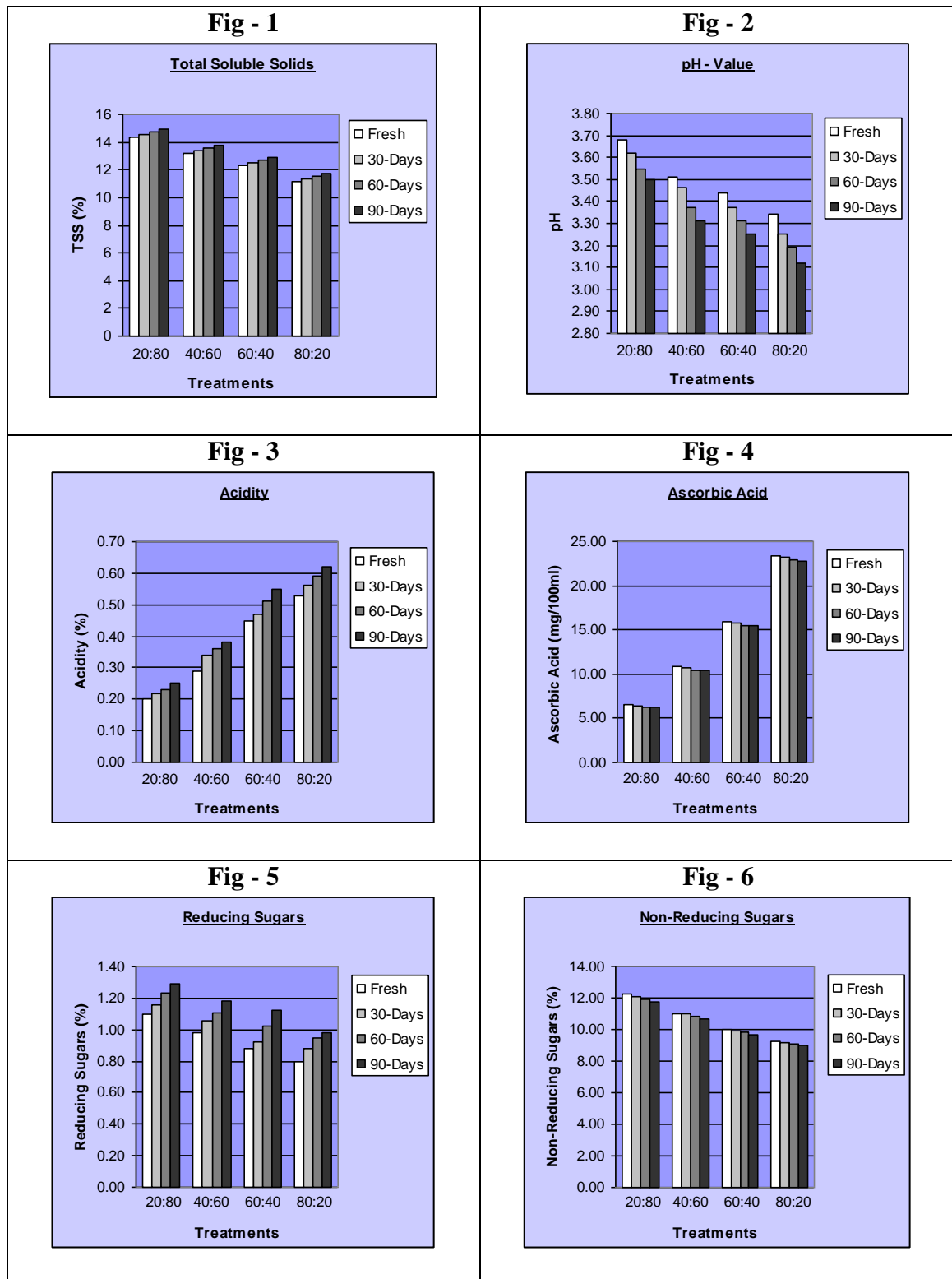


Figure 1. Effect of Storage on Chemical Properties of Kinnow and Sugarcane Juice Blends

### 3.6. Ascorbic Acid

The analytical results of the experiment showed that there was a substantial loss of ascorbic acid during storage (Fig-4). The results remained highly significant both for storage and treatments as given in Table-2. The degradation may be due to oxidation during handling, pasteurization and storage. The mean ascorbic acid contents of the applied treatments varied from (6.40-23.05 mg/100ml). It was observed that mean maximum content of (23.05 mg/100ml) was found in the treatment T4 (80:20 blend of kinnow and sugarcane juice). As

the sugarcane juice was decreased in the treatments, the ascorbic acid content decreased to considerable extent. The present findings are in close agreement with the research findings of Sahota *et al.* (2010) when naturally carbonated blended beverages were prepared from guava and lemon and ascorbic acid ranges of (2.9-27.8 and 8.4-25.7 mg/100 mL) were analyzed.

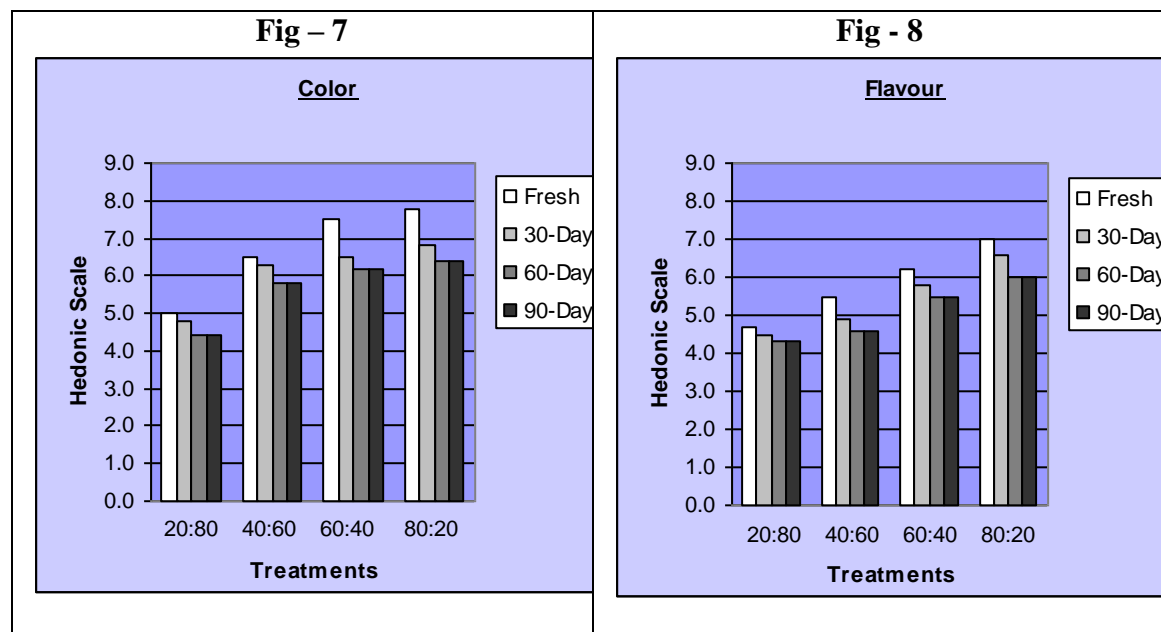
**3.7. Cloud Stability**

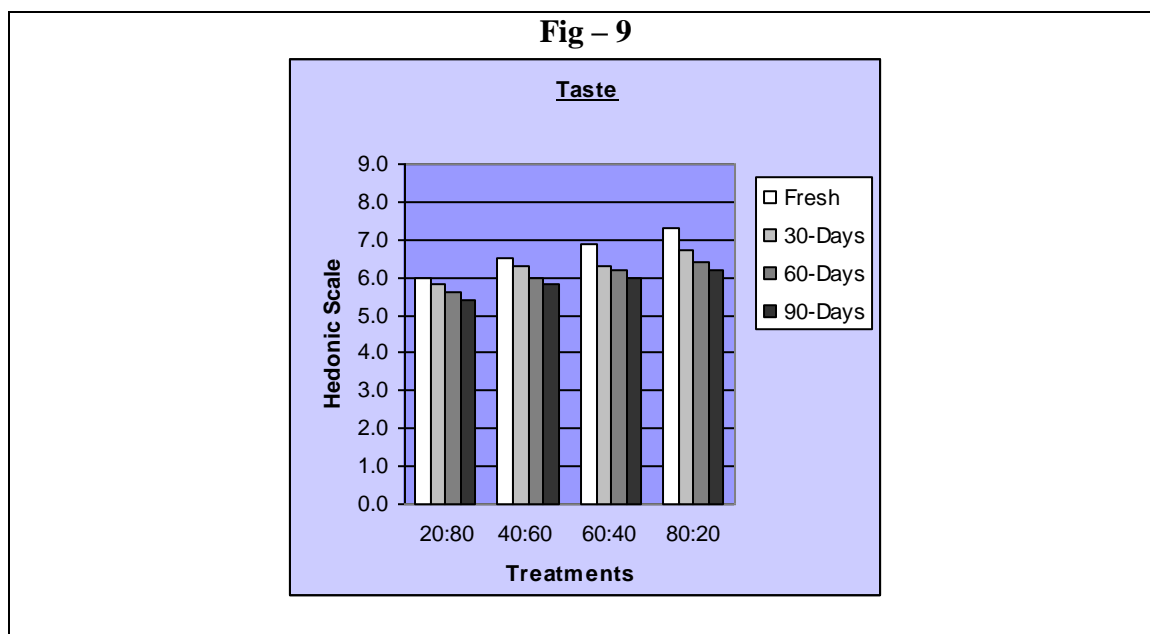
The blended samples of all the treatments were subjected to cloud stability test with uniform suspension method, at different intervals of storage period and results are presented in Table-1. The results showed that deterioration of all the samples increased during storage. The results are highly significant both for storage and treatments. The settling may be attributed to presence of pectic enzymes, particle size and viscosity of blends. The cloud stability values of all the treatments under study ranged from (8.10-15.98 cm). Mean maximum cloud formation was observed 15.98 cm in the treatment T4 (80:20 blend of kinnow and sugarcane juice). As the amount of kinnow juice decreased in the blends the cloud formation decreased. The lowest value (8.10 cm) was recorded in the treatment where 20:80 blend of juices were used respectively.

**3.8. Sensory Evaluation**

The evaluation was conducted by a panel of professional judges on the basis of nine point hedonic scale as described by Lee *et al.* (2003). The evaluation attributes (Color, flavor and taste) of juice blends (60:40 & 80:20) with higher contents of kinnow juice remained within acceptable limits as evident from Fig-7, 8 & 9. The pasteurized juice storage remained acceptable during 60 days by considering safe side.

The statistical analysis of the results indicated that all the sensory characteristics (color, flavor & taste) differ significantly with reference to treatments and storage intervals. The average scores of all the samples for color (Fig-7), flavor (Fig-8) and taste (Fig-9) decreased throughout the storage periods due to degradation which may be attributed to light, temperature, interaction of ingredients of blends, rancidity and oxidation of vitamins. The results regarding sensory evaluation are shown in Table-1. The mean scores of treatments ranged from (4.65-6.85), (4.45-6.40) and (5.70-6.65) regarding color, flavor and taste respectively. The highest scores of organoleptic evaluation were recorded in the samples containing more kinnow juice and consequently were liked more in respect of color, flavor and taste. The results of the study were also in line with the findings regarding utilization of kinnow and malta orange juices by masses (Pruthi *et al.*, 1984).





**Figure 2. Effect of Storage on Sensory Evaluation Characters of Kinnow and Sugarcane Juice Blends**

#### 4. Conclusion

From this study it was observed that good blends of kinnow and sugarcane juice were developed with acceptable sensory characteristics. The quality parameters for two blended juices revealed that TSS, acidity and reducing sugars were increased while pH and non-reducing sugars decreased during 90 days storage period. A decreasing trend in ascorbic acid content was observed and deterioration in cloud stability occurred with time. However, in subjective tests of sensory evaluation by the panel of judges, it was concluded that the treatments with higher kinnow juice contents i.e. kinnow : sugarcane (60:40 & 80:20) were pleasant for sensory attributes which had more acceptability by human taste. The pasteurized juice storage under ambient conditions was remained quite safe during 60 days within acceptable limits of sensory evaluation attributes. Such nutritive, tasty, ready to drink and economical beverages with good quality attributes may be introduced by the beverage industry to maintain healthy human life style.

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