

# Production and Evaluation of Storage Changes in Soursop-Juice

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**ABSTRACT---** *Pasteurized soursop juice was produced from the ripened fruit pulp (*Annona muricata* L.). The physico-chemical, microbial and sensorial qualities were evaluated during storage at refrigeration (6°C) and ambient (30°C) temperatures as samples A and B. The results showed that processing of the pulp into juice affected the physico-chemical and microbial properties. The storage study of the juice samples showed a rapid decrease in soluble solids, pH, protein and fibre in sample A by 61.17%, 26.83%, 59.10% and 64.71% than in sample B (25.14, 14.63, 30.91 and 34.12%). There were increases in the total microbial counts in sample A (1.36-7.91 log cfu/ml) and B (1.36-4.60 log cfu/ml cfu/ml). Same trend was observed for yeast and mould counts in sample A (1.14-4.45 log cfu/ml) and B (1.14-2.42 log cfu/ml) respectively. No coliform growth was observed in both samples. Overall, refrigerated sample B (64.10 %) was more sensorially acceptable than ambient sample A (25.64 %) during the storage period.*

**Keywords---** Soursop, pulp, juice, microbial, sensory quality

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## 1. INTRODUCTION

Fruits have been consumed as part of human diet over the years. They are also considered as food supplements and are recommended internationally as essential to healthy nutrition necessary for well being, because they contain high quantity and quality of water, sugars, vitamins, minerals and phytochemicals (Wardlaw, 2004; Potter and Hotchkiss, 2006; Ndife and Abbo, 2009).

Soursop (*Annona Muricata* L.) is also called prickly custard apple (English), Ebo (Yoruba), Mamphal (Indian), Guanabana (Spanish) and corossol and sappadille (French) is widely grown in Latin-American countries and commonly found in southern part of Nigeria (Onyechi, et al, 2012). It is one of the exotic fruits desired for its very pleasant aromatic and juicy flesh (Umme et al., 2001). The milky Soursop pulp when extracted is commonly consumed fresh, and can be made into candies, ice creams, beverages and as flavourings. The soursop leaves with its tender seeds are eaten as a vegetable because of their medicinal properties which is has been shown to be effective against indigestion, intestinal-inflammation and irritation, vomiting, cold and catarrh (Okwulehie and Alfred, 2010; Onyechi, et al, 2012). They also possess poultice properties and are used for the treatments of rheumatism and other skin diseases like eczema. The juice of the ripe soursop fruit can also be taken orally as a remedy for urethritis, haematuria and liver ailments (Okwulehie and Alfred, 2010; Wetwitayaklung et al, 2012) ).

The edible portion of the fruit constitutes 67.5% of total fruit weight. Soursop fruit is nutritionally high in carbohydrate, particularly fructose, and contain significant amount of vitamin C, Vitamin B<sub>1</sub> and Vitamin B<sub>2</sub> (Umme et al., 2001; Okwulehie and Alfred, 2010). The soursop fruit also contain proteins, fatty acids, minerals and is very rich in soluble and insoluble fibres (Arbaisah et al, 1997; Okunomo and Egho, 2010).

The processed pulp is used to prepare juices and can be fermented to make an apple cider-like drink called champola. Therefore, soursop is a potential source of raw materials for puree, juice, jelly, powder for fruit bars and flakes (Umme et al, 2001; Abbo et al, 2006; Onyechi, et al, 2012).

However, freshly extracted juice or drinks from soursop pulp is highly susceptible to spoilage than the whole fruit (Umme et al., 2001; Okwulehie and Alfred, 2010). The spoilage is accentuated by physico-chemical and enzymic changes involving oxidation and by microbial deterioration leading to fermentation (Gow-chin, 1996). These deteriorative changes impair both nutritional composition and the sensory attributes of the juice and makes it unfit for consumption (Okwulehie and Alfred, 2010).

Some of the technique of preserving fruits and vegetables from deterioration and subsequent total loss is to apply cold storage, as well as process them into fruit juices (Wenkam, 1990; Landon, 2007). During the processing, a large part of the quality attributes of the fresh fruits undergo remarkable changes which could affect the physicochemical, nutritional value and sensory perception of the fruit juice (Mannay and Shadaksharaswany, 2005; Landon, 2007). The goal of processing and preservation is to minimize these undesirable reactions while still maintaining and enhancing the

physical and nutritional quality, there by presenting a wholesome and acceptable product to the consumer, within a specified time period (Bates et al., 2001; Potter H, Hotchkiss I (2006).

Therefore the objectives of this study is to produce soursop drink from the soursop fruit-pulp and to evaluate the physiochemical, microbial and sensory changes of the soursop juice under ambient and refrigerated storage conditions.

## 2. MATERIALS AND METHODS

### 2.1. Preparation and Production of Soursop juice

Ripe soursop (*Annona muricata* L.) fruits were obtained from Kaduna municipal central market, in Kaduna state of Nigeria. The soursop fruits were thoroughly washed with potable water. Each soursop fruit was peeled, diced and decored to aid the removal of the seeds. The de-seeded core was blended with an electric blender using the cut and mix modes to produce a marshy pulp (part of which was taken for analysis). An equal volume of water was added in the ratio 1:1 (w/v, pulp/water) to aid the juice extraction process, with further blending. The blended pulp was then filtered using a muslin cloth. 10% sugar solution was added to bring the brix of the filtrate to 14% after which 0.1% sodium Benzoate was also added and the blending continued for 5 minutes. The soursop juice was then filled into sterilized glass bottles and corked and later batch pasteurized at 65°C for 15 minutes and allowed to cool.

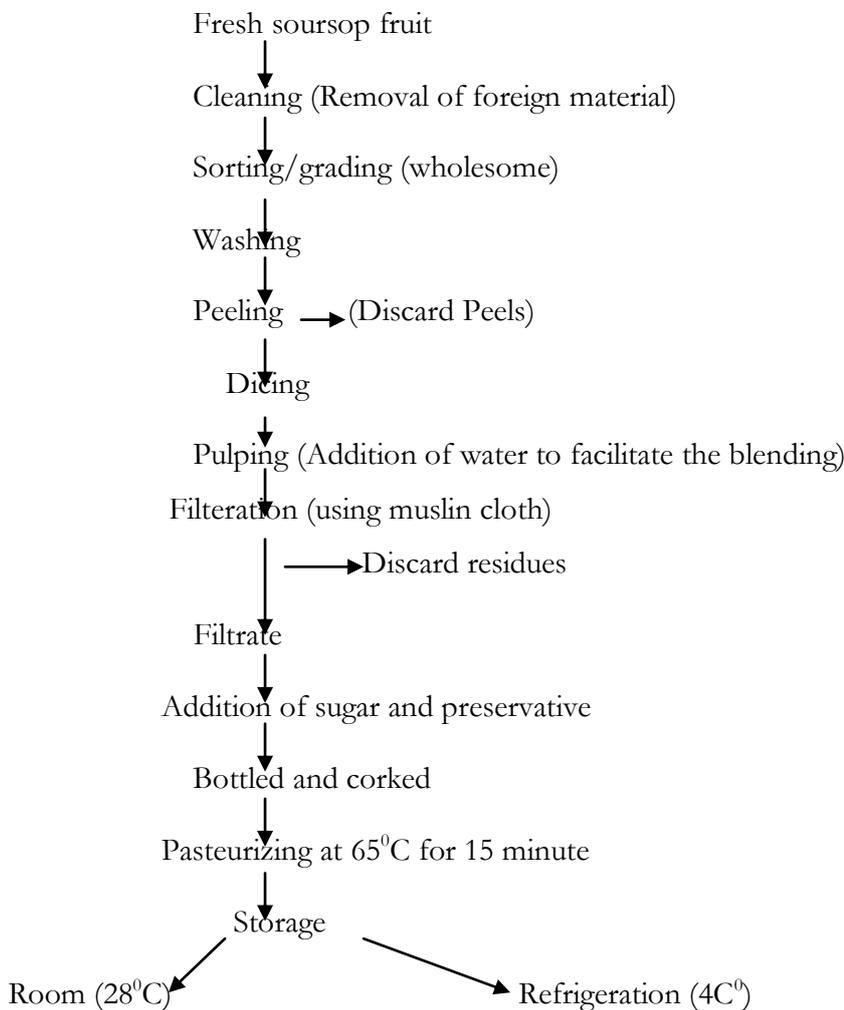


FIG.1 Flow chart for the production of soursop juice from soursop fruit.

### 2.2. Storage evaluation

The pasteurized soursop juice was divided into two and labeled A and B and were later stored at room (28-33°C) and refrigeration temperatures (4-6°C) respectively, from where samples were taken for analyses on a weekly interval for the 8weeks storage period.

### 2.3. Physico-chemical analysis

The pH and brix (soluble solids) and specific gravity of the juice samples were measured using instrumental methods (Jacobs, 1999). While the sweetness and astringency indexes were calculated as the ratio of soluble solids to acidity and vice versa (Wardy et al, 2009).

### 2.4. Proximate Analysis

The chemical composition of the soursop juices viz: moisture, protein, fat, crude fiber, ash contents and acidity were determined by methods described by AOAC (1990). Carbohydrate was calculated by difference, and energy was calculated using Atwater conversion factors.

### 2.5. Microbiological Assay

The determination of the microbial quality (mesophilic aerobic bacteria, coliforms, yeasts and mold counts) of the juices were performed by the method outlined in compendium of methods for the microbiological examination of foods (AMPH, 1992) with some modifications.

### 2.6. Sensory analysis

Sensory evaluation of the soursop juice samples were carried out by 20 panelists during the storage period, for the overall acceptability on a 9-point hedonic scale (9=liked extremely, 5=neither like nor disliked, and 1= disliked extremely) as described by Iwe (2010).

### 2.7. Statistical analysis

The results were statistically analyzed after triplicate sampling and their mean values and standard deviation presented (Ihekoronye and Ngoddy, 1985).

## 3. RESULTS AND DISCUSSION

The physico-chemical parameters analyzed for the soursop-fruit pulp and soursop juice are summarized in Table 1. The result shows that there were decreases in the values (%) for protein (79.44), fat (48.65), ash (53.55), carbohydrate(34.57) and acid content (72.67) of the soursop juice, while increases were observed for moisture content (36.01%), soluble solids (170.83%) and pH ( 31.53%)of soursop juice compared to the pulp. The values for the composition of soursop and the juice were similar to those reported by Umme et al. (2001) and Abbo et al., (2006). This is a reflection of the effects of processing of the fruit pulp into juice (Onyechi, et al, 2012).

The results also showed that the total viable counts for pasteurized soursop pulp was  $<7.5 \pm 0.41 \times 10^1$  and juice  $<1.5 \pm 0.22 \times 10^1$  cfu/ml, while the mould and yeast counts for pasteurized soursop pulp and juice were  $<2.5 \pm 0.43 \times 10^1$  and  $<1.4 \pm 0.25 \times 10^1$  cfu/ml respectively. There were no observable coliform growth in both soursop pulp and juice samples. This shows the soursop products to be microbiologically safe for human consumption.

**Table 1. The Physico-chemical and microbial composition of soursop products**

Parameters	Fresh Soursop pulp	Soursop Juice
Moisture (%)	65.14±2.31	88.60±2.83
protein (%)	5.35±0.24	1.10±0.18
Fat (%)	0.74±0.06	0.38±0.05
Crude fibre (%)	2.26±0.10	0.85±0.06
Ash (%)	1.83±0.15	0.74±0.05
Carbohydrate (%)	15.62±3.14	10.22±2.73
Total soluble solid (%)	5.28±0.12	14.32±0.47
pH	3.52±0.35	4.63±0.30
Titrateable acidity (%)	1.50±0.05	0.41±0.02
Total microbial counts (cfu/ml)	$7.5 \pm 0.41 \times 10^2$	$3.6 \pm 0.22 \times 10^1$
Total coliform counts (cfu/ml)	Nil	Nil
Total yeasts and mould counts (cfu/ml)	$9.2 \pm 0.43 \times 10^1$	$1.4 \pm 0.25 \times 10^1$

### 3.1. Changes in physical properties of soursop juice during storage.

The pH and soluble solids are physical properties that are most used as indicators to characterize the quality of juice and other beverage products (Arbaisah et al, 1997; Landon, 2007). Fig. 2 showed a decrease in soluble solids content for

samples A (14.32-5.56 %) and B (14.32-10.72). The same trend was observed for the pH in samples A (4.10-2.24) and B (4.10-2.83) respectively.

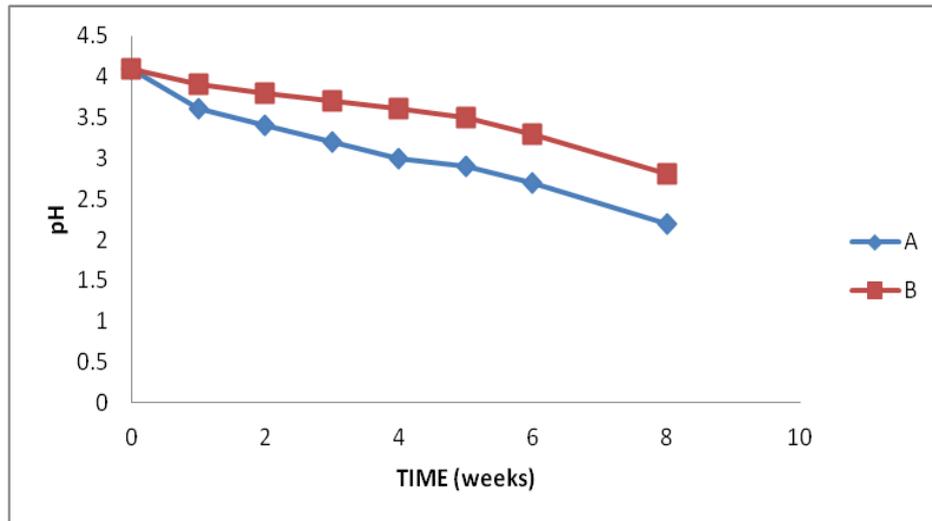


Fig. 2A: pH of soursop juice during ambient and cold storage

The slow changes recorded in soluble solids and pH of soursop juice in cold storage (sample B) compared to ambient (sample A) could be due to the effect of low temperatures in reducing chemical reactions. This could also affect the growth of microbes especially yeasts which are known to infect sugar and sugar products such as fruit juices that have low acid and initiate fermentation resulting in sugar reduction in the juice (Abbo et al, 2006). pH as an indicator of acidity is reported to also affect microbial activity (Ezeama, 2007). The most common acids in soursop fruits are citric and malic acids (Wenkam, 1990; Okunomo and Egho, 2010).

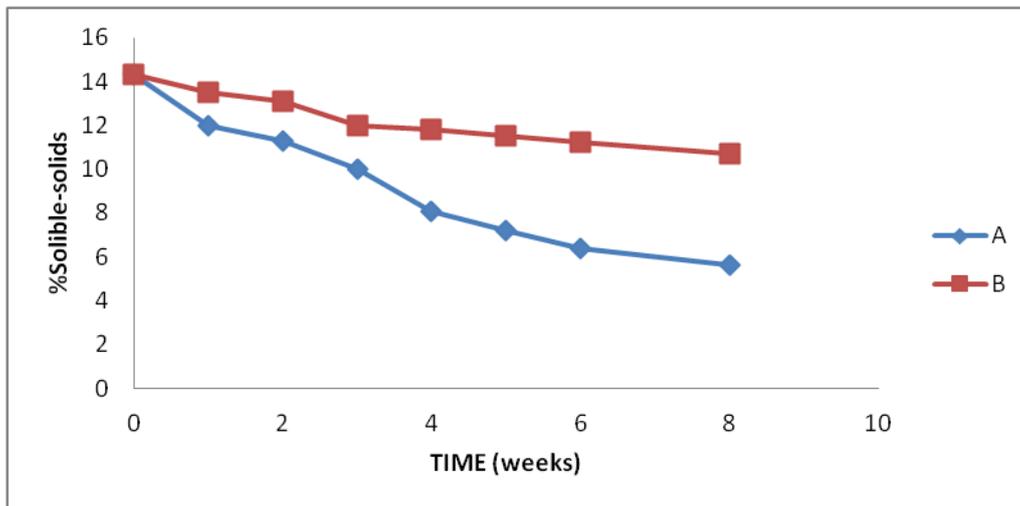


Fig.2B: Soluble solids (%) of soursop juice during ambient and cold storage

### 3.2. Changes in proximate content of soursop juice during storage.

It was observed that the proximate values of the protein and crude fibre contents of the both soursop -juice samples decreased with the storage time. Refrigerated juice sample A had higher protein retention (69.10%) than the ambient sample B (40.90%). This may be as a result of the low temperature employed and the microbial use of the protein as feed stock for survival and growth.

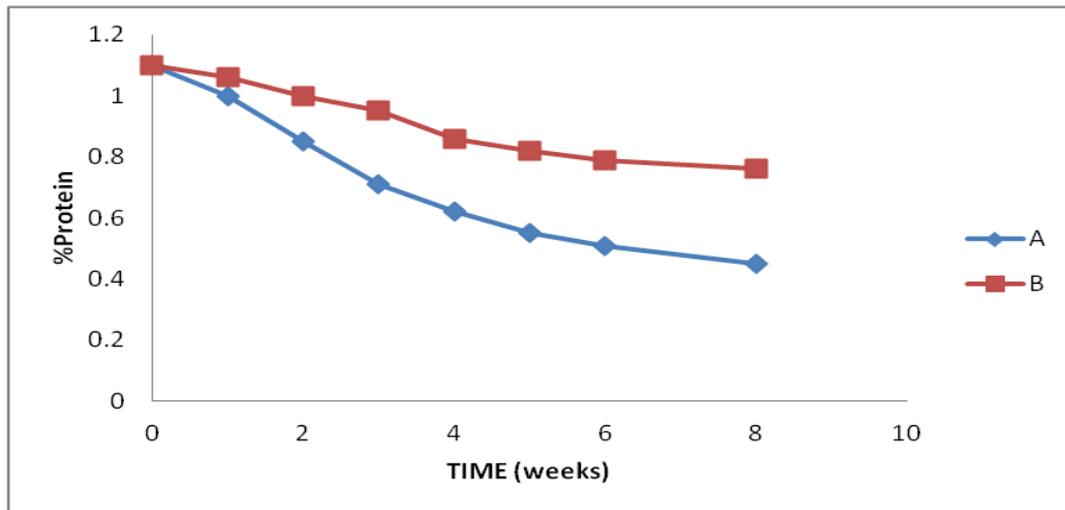


Fig. 3A: Protein content (%) of soursop juice during ambient and cold storage

Also the decrease in crude fibre content for sample A (64.71%) was higher than for sample B (34.12%) during storage. The reduction in the fibre content could be due to fermentative breakdown by resident microbes for their metabolic purposes (Onyechi, et al, 2012). The rate of breakdown was however influenced by the storage temperatures (Mannay and Shadaksharaswany, 2005; Pala and Toklucu, 2013).

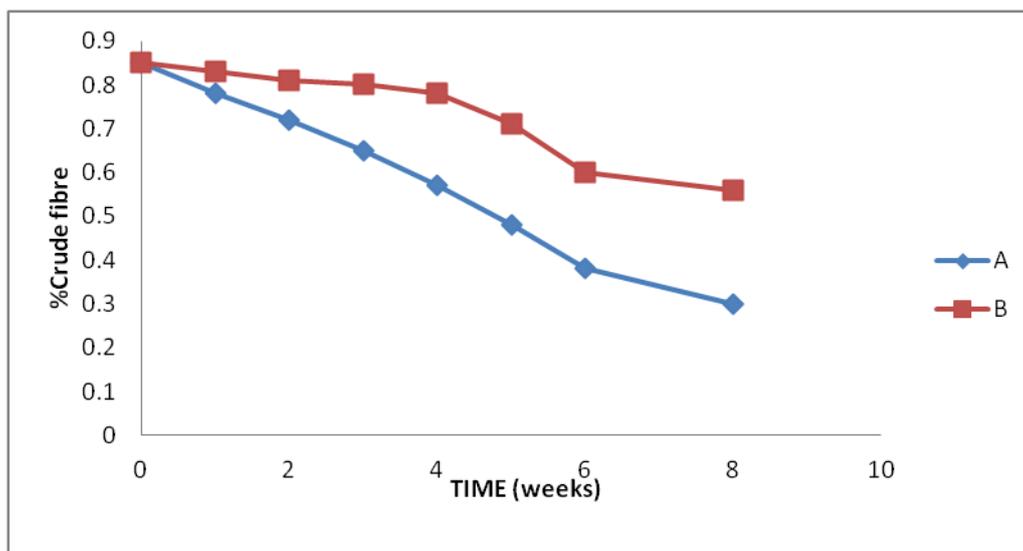


Fig. 3B: Crude fibre content (%) of soursop juice during ambient and cold storage

### 3.3. Changes in Microbial profile of soursop juice during storage

The results also showed that the total bacterial content of soursop juice samples was affected by storage conditions (Fig. 3B). The total microbial counts increased throughout the period of storage in sample A (1.56 – 7.96 log cfu/ml) and B (1.56 – 4.78 log cfu/ml). The increase was more rapid during the initial period and later became gradual with time. The total viable microbial counts of which majority were mesophilic aerobic bacteria decreased with the storage time. Bacteria are not known to thrive in acidic or low acid environments (Jay, 2000; Ezeama, 2007).

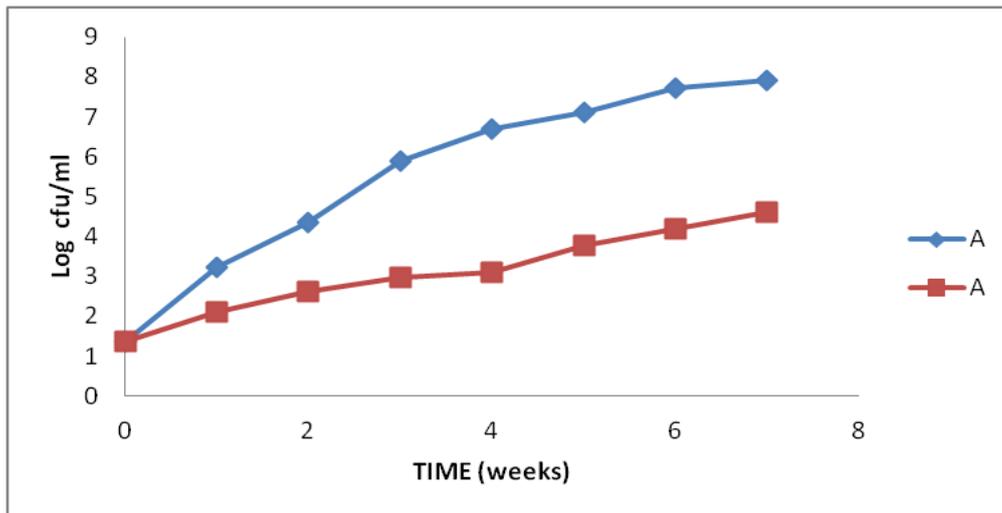


Fig. 4A: Total microbial counts of soursop juice during ambient and cold storage

The same trend was observed in the yeasts and mould counts in both samples A (1.15 – 4.65 log cfu/ml) and B (1.15– 2.62 log cfu/ml). However, the ambient samples (B) were more consistent in the increase in both their total microbial and yeast and mould counts (Fig. 4B).

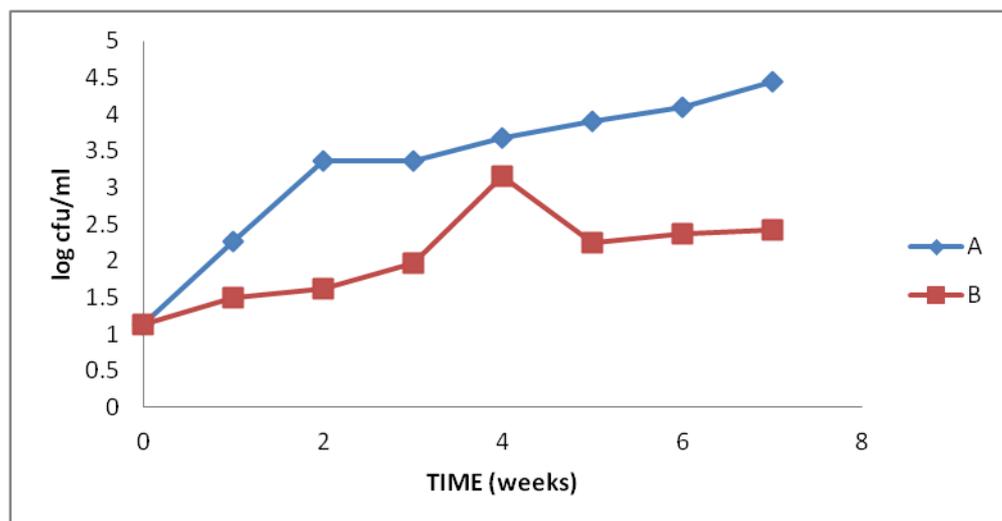


Fig.4B: Total yeasts and mould counts of soursop juice during ambient and cold storage

Yeast and mould growths are favoured by the presence of sugar and acid pH, which predispose them to attack by bacterial pathogens (Abbo et al, 2006; Ezeama 2007; Okwulehie and Alfred, 2010). Generally there were less total bacterial, mould and yeast growths in soursop juice stored at cold temperature (sample A) than at ambient (sample B). Okwulehie and Alfred (2010) also reported the isolation of the yeasts *Saccharomyces cerevisie*, *Candida albicans* *Torulopsis* sp. from the pulp of ripe soursop and the moulds, *Penicillium chrysogenum* and *Aspergillus niger* at 20% and above incidence.

There were no observable coliform growths in the soursop juices during the period of storage. This eliminates the possibility of faecal contamination in the soursop juice samples, which is a pointer to hygienic production and handling practice employed (Ezeama, 2007).

### 3.4. Sensory evaluation of soursop juice during storage

The sensorial evaluation depicted by the sweetness index and organoleptic preference for soursop juices stored at both ambient and refrigerated temperatures are shown in Figure 5. The sweetness index and the overall acceptability scores decreased drastically over the 8 weeks storage period. The

reductions were more pronounced in ambient sample A for sweetness index (87.18 %) and overall acceptability (74.36 %) than in refrigerated sample B (61.88% and 35.90 %).

The Sweetness index (SI) and the Astringency Index (AI) are used for the prediction of the tartness and sweetness of acid foods which affects organoleptic perception (Wardy et al., 2009; Aworh, 2010; Averbek and Schieberle, 2010). Fruit juices with sweetness index greater than 19 are regarded as sweet, with less acid by taste (Wardy et al., 2009).

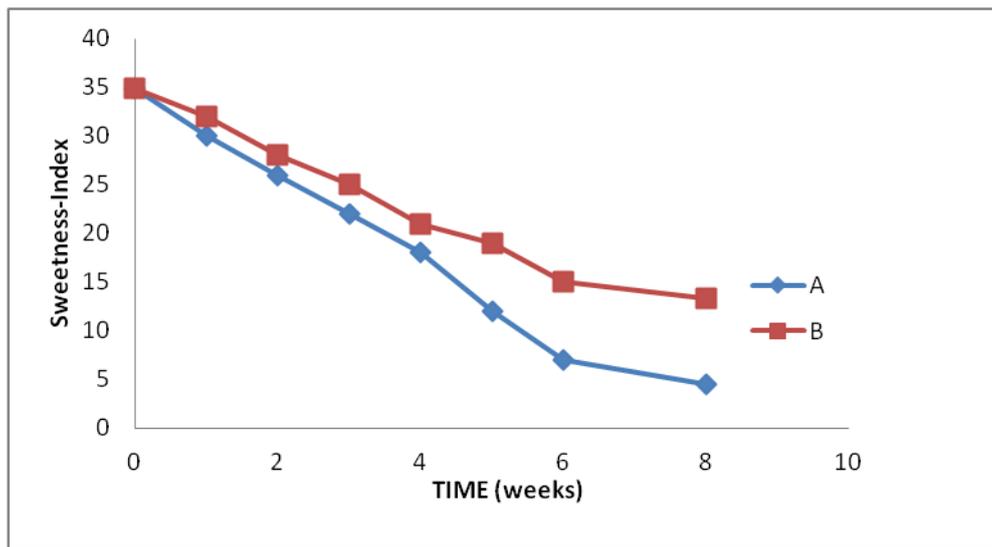


Fig. 5A: Sweetnes Index of soursop juice during ambient and cold storage

The juice samples overall acceptability was based on how the various organoleptic parameters like appearance, taste, aroma and flavour jointly appeal to the panelists. Averbek and Schieberle, (2010) reported that fruit acids influence sensorial characteristics of the juice products. Storage conditions particularly temperature was also reported to induce changes in fruit juices that include discolouration of the drink, increased water loss, increased susceptibility to secondary infections and detrimental changes in flavours (Gow- Chin Y.1996; Silveira et al, 2013).

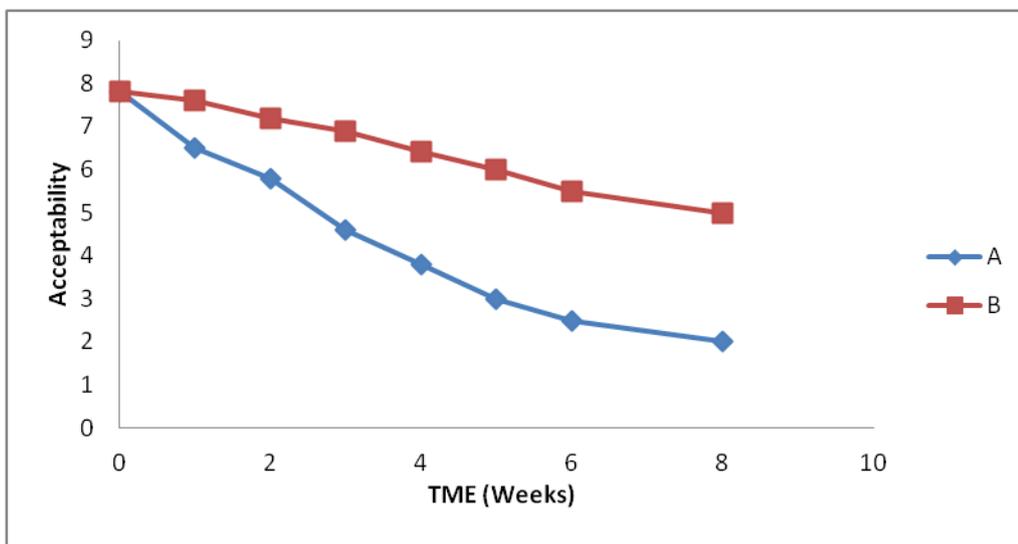


Fig.5B. Acceptability scores of soursop juice during ambient and cold storage

#### 4. CONCLUSION AND RECOMMENDATION

The production of soursop juice from the fruit was affected by the processing conditions. There were reductions in the physico-chemical and microbial content between the fresh pulp and the juice. There were deteriorations in all the quality attributes of the fruit juice samples during the storage period. The rate of deterioration was more pronounced in

juice stored at ambient than at refrigeration temperature. Consumption of these juices is regarded as microbiologically safe when refrigerated and desirable considering the refreshing and potential health benefits.

Further research should be done to process the soursop pulp into alternative concentrate and powder forms with retained phyto-nutrients and longer shelf life.

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