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Effect of Different Storage Condition on pH and Vitamin C Content in Some Selected Fruit Juices (Pineapple, Pawpaw and Watermelon)

Muhammad Auwal Ibrahim^{1*}

¹*Department of Food Science and Technology, Kano University of Science and Technology (KUST), Wudil, Kano, Nigeria.*

Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

This research work was carried out to determine the suitable storage condition of fruit juices that will effectively retain their vitamin C content and pH level. Three different samples of fruits were processed into their respective juices, they were then analyzed to determine the vitamin C content and pH level of each samples, and stored at different storage condition. The samples were then analyzed after every week for one month, and the result shows that vitamin C content reduced by 72.9% at room temperature and 47.9% at refrigeration temperature in Pineapple juice, 75.5% at room temperature and 47.2% at refrigeration temperature in Watermelon juice, and 69.4% at room temperature and 55.6% at refrigeration temperature in Pawpaw juice respectively. The analysis also shows that the pH level of the samples were reduced by 17% and 15.0% in Pineapple juice, 22.4% and 20.7% in Watermelon juice, 25.9% and 20.4% in Pawpaw juice at both room temperature and refrigeration temperature storage conditions respectively. Statistical analysis shows that there is no significance difference in term of vitamin C content and pH level between room temperature storage and refrigeration temperature at 5% level significance. It is therefore concluded that, storage of fruit juices at refrigeration temperature condition forms the basis of recommendation of this research.

*Corresponding author: E-mail: kanawa2015@gmail.com;

Keywords: Vitamin C; pH; storage temperature; pineapple juice; papaya juice and watermelon juice.

1. INTRODUCTION

Fruits and vegetables are “juicy foods” that consist mostly of water, but they also provide a variety of vitamins, minerals, phytonutrients, and a good amount of fiber that helps fill you up [1]. The Juice is a liquid (drink) that is naturally contained in fruit and vegetables. It can also refer to liquids that are flavored with these or other biological food sources such as meat and seafood. It is commonly consumed as a beverage or used as an ingredient or flavoring in foods [2]. Fruit juice isn't the same as intact fruit and it has as much sugar as many classical sugar drinks [3].

From the health perspective, fruit juice was recommended by pediatricians as a source of vitamin C and an extra source of water for healthy infants and young children as their diets expanded to include solid foods with higher renal solute [4]. As a part of healthy diet, juices help in all sorts of ways -- to keep the digestive system in order, fight infection and diseases [5]. The ability of fruit juice to boost immune system function, reduce signs of aging, protect against cancer, boost cellular repair and metabolism, detoxify the body, improve circulation, improves blood pressure, reduces inflammation, and lowers cholesterol levels [6], therefore, make it mandatory to find the best method to preserve the juices for off season uses, which form the basis of this research.

However, despite the many pathways to deterioration, there are a number of effective preservation methods that have evolved to combat spoilage [7]. Although air is one of the primary factors that will cause degradation of the juice [8]. A principle tenant of food preservation is to maintain the quality and nutritional attributes while preventing spoilage. In general, the fresher the juice, the higher the quality, so the standard of excellence is often freshly prepared unprocessed juice [7].

The retention of vitamin C is often used as an estimate for the overall nutrient retention of food products because it is highly sensitive to oxidation and leaching into water-soluble media during storage, it begins to degrade immediately after harvest and degrades steadily during prolonged storage [9]. Although the degradation of ascorbic acid is known to be affected by pH, the change in pH during the storage was not

significant [10]. pH is determinant of juice quality and the stabilization of juice color is mainly due to pH effect [11]. Products with low pH will have their shelf lives increased [12].

Food preservation is the process of treating and handling food to stop or slow spoilage [loss of quality, edibility or nutritional values] and thus allow for longer storage. Preservation of juices involves preventing the growth of bacteria, yeast, fungi and other micro organisms [13].

However, this study was carried out to determine the effect of different storage conditions on pH and vitamin C content of Pawpaw juice, Pineapple juice and Watermelon juice respectively.

1.1 Aim of the Research

The aim of the research is to find out the suitable storage condition of fruit juices that will effectively retain their vitamins and appropriate organic acid level.

1.2 The Specific Objectives

1. To process and store fruit juices under different storage conditions.
2. To determine the amount of vitamins and organic acid present before and after one month.
3. To determine which of the above storage method retained more vitamins and appropriate pH level, and therefore form the basis for recommendation to the public.

2. MATERIALS AND METHODS

2.1 Method of Processing Fruit Juice

Each of the three different samples of fruits (Pineapple, Pawpaw and Watermelon) was carefully sorted, washed, and peeled to desirable sizes. The juice was extracted from the juicer and filtered. One kilogram (1 kg) of sugar was mixed with five hundred (500 ml) of water to make a syrup, and the mixture was heated up to 90°C without boiling and then let it cool down. Sugar solution was added with equal volume of filtered juice and water, and then stirred well to achieve proper mixing. Prepared fruit juices were then filled and sealed in plastic bottles, the filled juices stored at different conditions.

2.2 Juice Storage

Equal number of prepared and sealed juices were stored at room temperature of (29°C to 31°C), and other half at refrigeration temperature (4.5°C to 7°C).

2.3 Analysis of the Stored Juices

Analyses to determine the vitamin C content and organic acid level were carried out immediately after processing and after every week for one month. The mean of recorded value obtained after repeating analyses (of both vitamin C and pH content) three times were taken.

2.4 Vitamin C Determination

2.1.4.1 Method

Iodine titration method [14].

2.1.4.2 Titration

50cm³ un-concentrated juice was pipette into 100cm³ volumetric flask. 25 cm³ of 20% acetic acid was added as stabilizing agent and was diluted to 100 cm³. 10 cm was pipette into a conical flask, and 2.5 cm³ acetone was added. It was titrated with 2, 6-Dichloroindophenol (DCIP) Standard solution. A faint pink color that was

persisted for about 15 seconds was observed. The amount of dye used in the titration was determined volumetrically and used in the calculation of the vitamin C content mg/ 100ml in the fruit samples [15].

2.5 Determination of pH Content

pH was determined using standard pH meter, Expandable Ion Analyzer EA 920. The meter was standardized using buffers 7 and 4 before obtaining readings.

3. RESULTS AND DISCUSSION

3.1 RESULTS

The results obtained at the end of this research were tabulated in details below. Table 1 shows results for the reduction of Vitamin C after one month, while Table 2 also shows the changes of pH value of the fruit juices after one month.

3.2 DISCUSSION

3.2.1 pH content

The baseline pH values of the juices were found to be 4.0 in fresh pineapple juice and that of the fresh watermelon juice was 4.6 with pawpaw having 5.4. The pH of the three samples were

Table 1. Ascorbic acid content (mg/100 ml) of different fruit juice samples

S/N	Sample code	Zero week	First week	Second week	Third week	Fourth week	Percent reduced
1	PA-RM	4.8	2.5	1.8	1.4	1.3	72.9
2	PA-RF	-	4.0	3.9	3.5	2.5	47.9
3	WM-RM	5.3	3.5	2.5	1.9	1.4	75.5
4	WM-RF	-	3.9	3.5	3.2	2.8	47.2
5	PP-RM	7.2	6.4	4.8	4.2	2.2	69.4
6	PP-RF	-	6.8	5.2	3.9	3.2	55.6

Key: PA-RM = Pineapple at Room Temp.
WM-RM= Water Melon at Room Temp.
PP-RM= Pawpaw at Room Temp.

PA-RF= Pineapple at Refrig. Temp.
WM-RF= Water Melon at Refrig. Temp.
PP-RF= Pawpaw at Reffrig. Temp.

Table 2. pH level (mg/100 ml)of different fruit juice samples

S/N	Sample code	Zero week	First week	Second week	Third week	Fourth week	Percent reduced
1	PA-RM	4.0	3.8	3.6	3.4	3.3	17.5
2	PA-RF	-	3.9	3.8	3.6	3.4	15.0
3	WM-RM	5.8	5.4	5.1	4.8	4.5	20.7
4	WM-RF	-	5.6	5.3	5.0	4.6	22.4
5	PP-RM	5.4	5.0	4.7	4.5	4.0	20.4
6	PP-RF	-	5.1	4.9	4.7	4.3	25.9

Key: PA-RM = Pineapple at Room Temp.
WM-RM= Water Melon at Room Temp.
PP-RM= Pawpawa at Room Temp.

PA-RF= Pineapple at Refrig. Temp.
WM-RF= Water Melon at Refrig. Temp.
PP-RF= Pawpaw at Reffrig. Temp.

founded to be increasing, juices are becoming more acidic under various storage conditions from the production day to four weeks time. At room temperature, the pH content of Pineapple juice ranges from 4.0 to 3.3, 5.6 to 4.5 in Watermelon juice and that of Pawpaw ranges from 5.4 to 4.0 respectively. At refrigeration temperature, the pH content of Pineapple ranges from 4.0 to 3.4, Watermelon 5.6 to 4.5 and that of Pawpaw ranges from 5.4 to 4.3 respectively. The results are comparable to that obtained by V.O. Ajibola et al. [16] (5.53 to 6.93 at RT and 5.53 to 6.41 at RC in pineapple juice, 5.87 to 6.70 at RT and 5.87 to 6.27 at RC in pawpaw juice). A value of 3.11 to 3.65 at RT and 3.09 to 3.72 at RC was recorded by Moses et al. [13]. The pH for the samples, an indication of high acidity may confer longer keeping quality on all the juices as reported in the previous work [17]. However, the pH levels of the juice samples indicated that they are slightly acidic [18]. The increased pH was due to the decrease in acidity of the juices. Fruit juices have a low pH because they are comparatively rich in organic acids [19]. Also the observed trend of pH could be as a result of storage temperature [preservation methods] and type of fruits used for the production of the juices. It is also possible to have biochemical reaction taking place during storage periods together with microbial action in the juices [13].

3.2.2 Vitamin C content

The Vitamin C content of fresh juices was 4.8 mg/100ml in Pineapple juice, 5.3 mg/100 ml in Watermelon juice and 7.2 mg/100 ml in Pawpaw juice. During the period of four weeks, the vitamin C content was found reduced significantly at both room temperature condition and at refrigeration temperature conditions. At room temperature, the vitamin C content ranges from 1.3 to 4.8 mg/100 ml, 1.4 to 5.3 mg/100 ml in Watermelon juice and 2.2 to 7.2 mg/100 ml in Pawpaw juice. At refrigeration condition, the vitamin C content in Pineapple juice ranges from 2.5 to 4.8 mg/100 ml, 2.8 to 5.3 mg/100 ml in Watermelon juice and 3.2 to 7.2 mg/100 ml in Pawpaw juice respectively. Based on C.C. Nweze finding, a value of 6.40 mg/100 and 4.08 mg/100 ml was found in fresh pineapple and watermelon juices [18] and Pawpaw (9.31 mg/100 ml) [20]. So also, a value of 46.70 at RT and 44.3 at RC was found in Watermelon juice and 50.2 at RT and 49.00 at RC in pineapple [13], a value of 6.9 at RT for weeks was also observed by Shamma et al. [21]. Furthermore, it was observed that the preservation method to

which the juice samples were subjected to played a crucial role as far as the vitamin C contents are concerned at the end of the storage period. Low temperature can slow down the rate of degradation of vitamin C generally [22] while the great [high] losses seen in juice samples stored at room temperature may be as result of oxidation reaction by residual oxygen, followed by decomposition which may have been accelerated due to storage temperature [23].

To conclude this discussion, the study supports the common human perception that fresh juices are often best for optimal vitamin C and pH content, hence storage of the juices at either of the ways for a long period leads to deterioration of nutritional values.

4. CONCLUSION

The results obtained after an accurate analysis and precise measurement shows that refrigeration storage is more preferable because it retained 52.1% vitamin C and 85% pH in Pineapple juice, 52.8% vitamin C and 79.3% pH level in Watermelon juice, and 44.4% vitamin C and 79.6% pH level in Pawpaw juice respectively.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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