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Effect of Drying Temperatures on the Vitamin C Content of Pineapple Fruit (*Ananas comosus*)

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Abstract

In this study, the effect of processing and drying temperature on the Vitamin C content of pineapples using an electric oven as a case study was done. Samples of fresh pineapple fruit were dried to equilibrium moisture content under different constant oven temperatures ranging from 40°C to 70°C and under open air sun drying using the fresh sample as a control. Vitamin C analysis of the fresh pineapple and dried samples were then carried out. The results showed a significant difference ($\alpha = 0.05$) in the concentrations of Vitamins C between the fresh samples and the dried samples with the fresh sample having the least concentration value of 0.018g/100g. Among the dried samples, the ones dried at oven temperature of 50°C significantly had the highest concentration value of 0.294g/100g while the open air sun dried samples yielded the least concentration (0.093g/100g) of Vitamin C content. In all cases, as would be expected increasing the drying temperature led to reduction in drying time. It can be concluded that the optimum temperature for drying of pineapple fruits is 50°C.

Keywords: Temperature, Pineapple, Oven, Optimum, Vitamin C.

1. Introduction

Food processing techniques have improved considerably over the years and more studies are being carried out to, make food processing more efficient. The processing and drying of the pineapple fruit leads to the destruction and loss of its important nutrients [1]. These losses which usually occur as a result of thermal destruction of nutrients, is dependent on the method of processing adopted. Hence, the need for comparative study of impact of different process temperatures on the nutrient contents of pineapple. Pineapple is the fruit of *Ananas comosus*, an indigenous perennial crop of South America and is consumed among other things for richness in Vitamin C [2, 3]. In Africa, Nigeria and Kenya are major producers of pineapple fruit [4]. Its consumption helps to improve immune system's ability to fight against cancer due to the presence of carotenoids [5]. In addition to Vitamin C, it also contains phenolic compounds as antioxidant. This compound is responsible for the taste and colour of the fruit. It has been shown to have a significant effect on human healthiness through its anti- inflammatory activities in the human cells [6]. Vitamin C is a very important nutrient needed by the body and it is readily found in pineapples and most times it gets wasted. Vitamin C content is about 95% of total vitamin content of pinapples [7, 4]. Vitamin C is a key antioxidant that can stop the development of negative medical issues like heart related diseases and cancer. It is among the most important antioxidants used in scavenging reactive oxygen in human cells, thereby, protecting cells from destruction [8, 9]. Several works have been done on the Vitamin C content of fruit and vegetables of which pineapple fruit is part of Igwemmar et al. [10] studied on the impact of heating time on the Vitamin C content of some chosen vegetables. The effect of processing method and storage time on the Vitamin C content of some pineapple varieties in the Rivers State of Nigeria was studied by [11]. Ojike et al. [12] studied on the influence of solar dryers on the vitamin content of pawpaw. From these previous studies, attention has not been paid to determining the optimum temperature for processing and specifically for drying of fruits especially pineapples in relation to conservation of Vitamin C content of the fruit. Hence, this work seeks to investigate how drying temperature affects the Vitamin C content in pineapple with a view to establishing an optimum temperature for drying of pineapples.

2. Materials and Methods

Fresh pineapple fruits were sourced from Nsukka local market and used for the study (Figure 1). The fresh fruits were peeled, washed, cored and cut up in to thin slices of about 2cm thick each. Then, the whole lot was divided into three: one for the fresh sample. This sample was used as a reference during the comparative analysis with the samples obtained from the different methods of drying. The second lot was used for open air sun drying method and the other for the oven drying system.

The lot for the open air sun drying system was put in a tray lined with a dry sack and kept under the direct rays of the sun the weight of the samples were taken every one (1) hour with the use of a portable digital scale until a constant weight was obtained. The open air drying took a total of about three (3) days to be completed.

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Figure 1: Fresh pineapple fruit.

The samples were completely dried between August 3^{rd} and 5^{th} 2019. The dried samples were put in a desiccator in the laboratory to prevent them from absorbing more moisture from the atmosphere and rotting out completely before it was processed for Vitamin C content analysis. The samples for oven drying were put in ceramic saucers which had been washed and rinsed with distilled water and then put in an electric oven. The oven temperature was varied for different samples and their weights were recorded every hour until the samples were completely dry. The oven dried samples were varied in temperatures ranging from 40°C, 45°C, 50°C, 55°C, 60°C, 65°C and 70°C respectively. The procedure was replicated three times. The electric oven used for the study is shown in Figure 2 with model number DNG- 9101, voltage 220V, frequency 50Hz and a power rating of 750W.

The Vitamin C analysis of the samples obtained was carried out in the Food Chemistry and Analysis Laboratory of the Department of Food Science and Technology of the University of Nigeria Nsukka using the method of Khan et al. [13]. 1gram each of the samples was weighed into test tubes and 4ml of 0.4% of oxalic acid was added. 1ml of Conc. H2SO4 was then added with 2ml of ammonium molybdate. 3ml distilled water was added to the test tubes which were shaken and allowed to stand in a test tube rack for about 5minutes. The absorbance values of the supernatant were obtained from a spectrophotometer which was set at 760nm. The absorbance values obtained was used in the calculations for the amount of Vitamin C present in each of the samples using Equation 1 where *ABS* stands for absorptivity of the sample obtained from a spectrophotometer.

$$\text{Vitamin C concentration} = ABS^{*}0.01005^{*}1000 \quad (1)$$

The statistical analysis for the vitamin concentrations was done using the Completely Randomized Design (CRD) Method in addition to F-LSD multiple comparison tests at 5% probability level [14].

3. Results and Discussion

Figure 3 shows the graph of average drying time for each of the drying temperatures in the oven. As expected the higher the drying temperature, the faster the drying process. Hence, drying the samples at oven temperature of 70°C gave the least time of 3 hours while 40°C oven temperature resulted to maximum time of 6 hours.

Figure 2: An electric oven.

Figure 4 shows a graphical representation of the Vitamin C content obtained from the different samples. It can be seen that the drying of the pineapple fruit causes an increase in the concentration of Vitamin C present in the fruit as a result of the reduction in the moisture content. From the graph, among the dried samples, the open air dried samples were least in vitamin-C content while the oven dried samples dried at 50°C had the highest Vitamin C value followed by the 45°C, 40°C and then the 55°C samples respectively. Equally, the entire oven dried samples had higher values than the open air dried samples. The fresh samples gave an average value of 0.018g/100g. This value is in line with works of Viana et al. [15] and Kongsuwan et al. [16] that observed values of 0.018, 0.015, 0.021 and 0.016 g/100g in their respective studies using various varieties of fresh pineapple fruits.

Table 1 shows the differences between the average values of the Vitamin C concentrations from different processes where the superscripts represent the level of significance at five percent probability level. Differing superscripts letters indicates that the differences in average values are significant. From the table, the concentration of Vitamin C which gave the highest value among the processes is significantly different from all other concentrations. This simply signifies that the optimum temperature among the selected temperatures for the drying and processing of pineapple fruit is 50°C. Equally processing temperature significantly affects the concentration of Vitamin C. this is in agreement with literature. Eze and Ojike [14] observed that Vitamin C content of fruits fluctuates depending on the heat of the drying systems used.

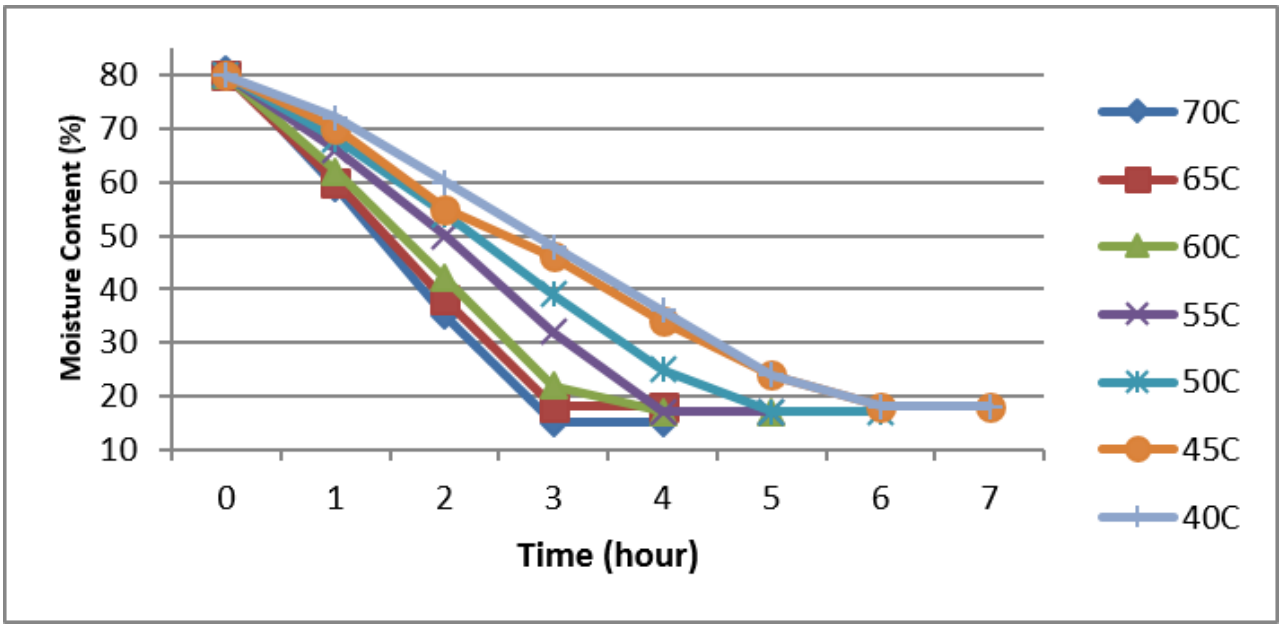

Figure 3: Oven Moisture Content-Time Graph.

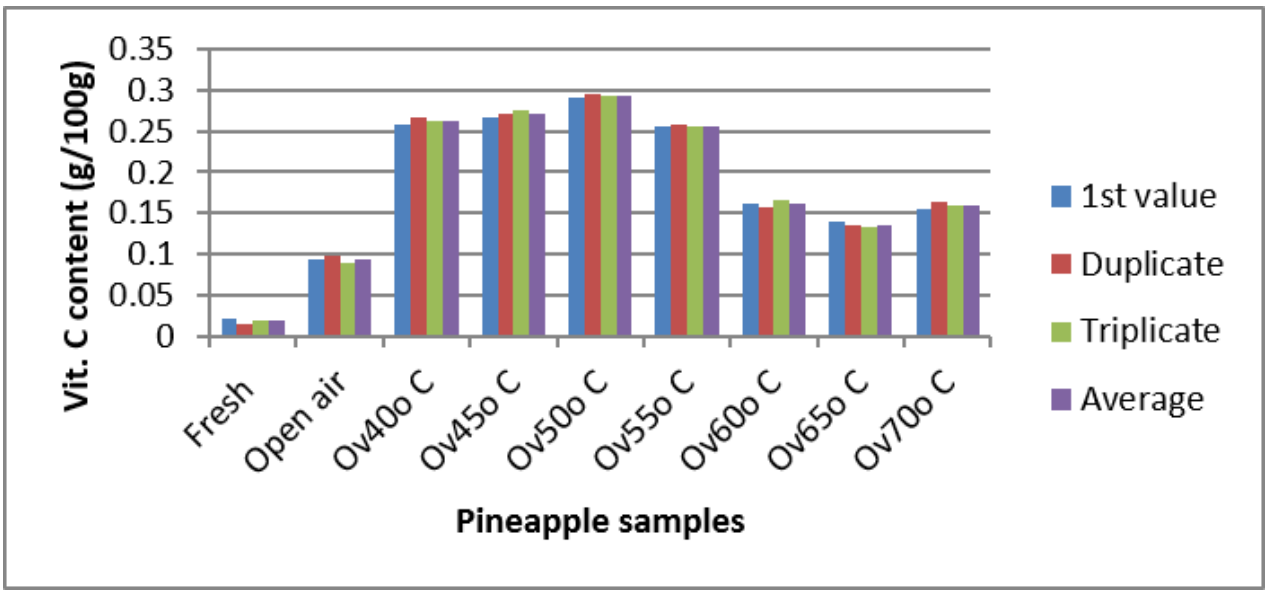

Figure 4: Graph showing the Vitamin-C contents of different samples.

Table 1: Average values of Vitamin C concentrations.

Samples	Average (g/100g)
Fresh	0.018 ± 0.009^{f}
Open air	0.093 ± 0.007^{e}
Oven at 40°C	0.262 ± 0.010^{b}
Oven at 45°C	0.271 ± 0.011^{b}
Oven at 50°C	0.294 ± 0.020^{a}
Oven at 55°C	0.257 ± 0.013^{b}
Oven at 60°C	0.162 ± 0.004^{c}
Oven at 65°C	0.136 ± 0.033^{d}
Oven at 70°C	0.159 ± 0.037^{c}

4. Conclusions

From the results obtained, it can be seen that the drying of the pineapple fruits leads to the higher concentration of Vitamin C present. Equally, it can be concluded that the optimum temperature for drying of pineapple fruits is 50°C. Drying products with relatively high moisture contents can increase their shelf life thus reducing post harvest losses and making the producing communities self sufficient in the production of the crop, prevents avoidable losses in revenue and equally make the product available during off-season periods.

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