Processing and Packaging of *Hibiscus Sabdariffa* for Preservation of Nutritional Constituents.

Anthony D. Joseph and Gideon Majiyebo Adogbo

Abstract: The storage of extracts of *Hibiscus Sabdariffa* is faced with the problem of contamination by bacteria which result to fermentation of the food drink and spoilage within a short period. To improve the processing of *Hibiscus sabdariffa* calyces into drinks, the calyces were dry processed and packaged in tea bags under conditions that would preserve the desirable contents such as anthocyanins, vitamin C, protein and minerals. Varied weights of 0.5g, 1.0g, 1.5g and 2.0g were infused in 500ml of water at 80^{o}C; Concentration of the extract was obtained from analysis of aliquots taken at 2 minutes interval on a spectrophotometer at a wavelength of 520nm. 2.0g sample gave the optimum extraction at constant temperature. The extraction rate is more proportionally dependent on amount of calyx than temperature. The analysis of the nutritional constituents was carried out with the 1.0g of calyx infused in 400ml of water and the temperature was varied. The result showed that increase in temperature favours the yield of protein, calcium, carotene and phosphorous but does not favour increase in ascorbic acid content of the aliquot. The temperature range of 60-70^{o}C is recommended for infusion such that the active constituents are preserved.

Key words: Hibiscus Sabdariffa, Drying, Packaging, Concentration, Temperature.

1.0 INTRODUCTION

Roselle *(Hibiscus sabdariffa)* is an annual herb that is grown in the tropics and it is widely cultivated in Nigeria mainly in the North-Eastern and Middle-belt regions. It contains anthocyanins, sugar and is used for medicinal purposes but it is widely used in making a fruit drink popularly known as 'Zobo' in Nigeria[1], [2], [3], [4], [5]. The roselle calyx is susceptible to decomposition thus it is essential to dry it. Drying is probably the oldest and the most important method of food preservation practiced by humans, it is one of the main post-harvest operations for biological materials since it has great effects on the quality of the dried products by maintaining the nutritional properties basically the ascorbic acid content [6], [7], it reduces the moisture content from 86% to 16% or 14% for improved preservation which is currently done by direct exposure of the calyx to the sun [8].

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The production process of *Hibiscus Sabdariffa* drink has not been mechanized nor standardized; the shelf life of the drink is less than two days due to microbial attack making it to lose its physico-chemical properties and organoleptic quality [3][9]. Amusa et al.,[10] investigated the microbiological and nutritional quality of freshly processed and hawked zobo drinks, the hawked zobo drinks harboured *Bacillus cereus, B. subtilis, Proteus* spp., *Pseudomonas aeruginosa, Streptococcus pyogenes, Staphylococcus aureus* and *Escherichia coli*. However, the freshly processed zobo drinks harbored no bacteria. The mode of packaging also affects the shelf life of the drink; proper packaging proves to be a means of preventing loss of quality of products as improper packaging can cause microbial contamination of the drink, Adogbo et al.,[11] reported that 2.0g of the calyces per tea bag is considered adequate for daily dosage at infusion temperatures of 40 - 60 °C. Packaging materials often used includes: plastic bottles, glass bottles and polyethylene sachets. In most cases there are no considerations for the suitability of these packaging materials [3]. Due to the set back faced by the liquid extract this research work is designed to find a suitable process in which the calyces of *Hibiscus sabdariffa* would be dry processed and

packaged in such a way that it can be readily prepared fresh at table to the desired quantity and also retain its nutritional constituent.

2.0 METHODS AND MATERIALS

2.1 Physical Processing of *Hibiscus sabdariffa* as a Drink

Two varieties of *Hibiscus sabdariffa* were obtained and the dirt was sorted out by winnowing. These varieties were mixed and dried in the oven to further reduce the moisture content. The dried calyces were then crushed to a mesh size of 200 micron and sieved. These tea size particles were then stored in an air tight vessel awaiting fortification with additives before finally packaging it.

One gram of the processed calyx was poured into an empty tea bag and sealed. Twenty tea bags were produced and packaged in the same way and finally packed in a cardboard box. This was then sealed with polythene to prevent the flow of moisture through it.

Spectrophotometric analysis was carried out at room temperature for the four different weights (0.5g, 1.0g, 1.5g, and 2.0g) of the bagged calyx, for each weight three different volumes of water (300ml, 400ml, and 500ml) were used for the extraction. During the process of the extraction aliquots were taken at an interval of 2minutes.The absorbances of the aliquots taken were determined using the photospectrometer at a wave length of 520nm.

2.2 Chemical Analysis

Ascorbic acid content was determined using titrimetric method, Protein content was determined using the micro kjeldahl method , ultra-violet light absorbtion method was used in determining the presence of β-Carotene while Atomic Absorption Spectra was used in determining the presence of iron, calcium and Phosphorus, detailed analysis is described by James [12] and AOAC [13].

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3.0 RESULTS AND DISCUSSION.

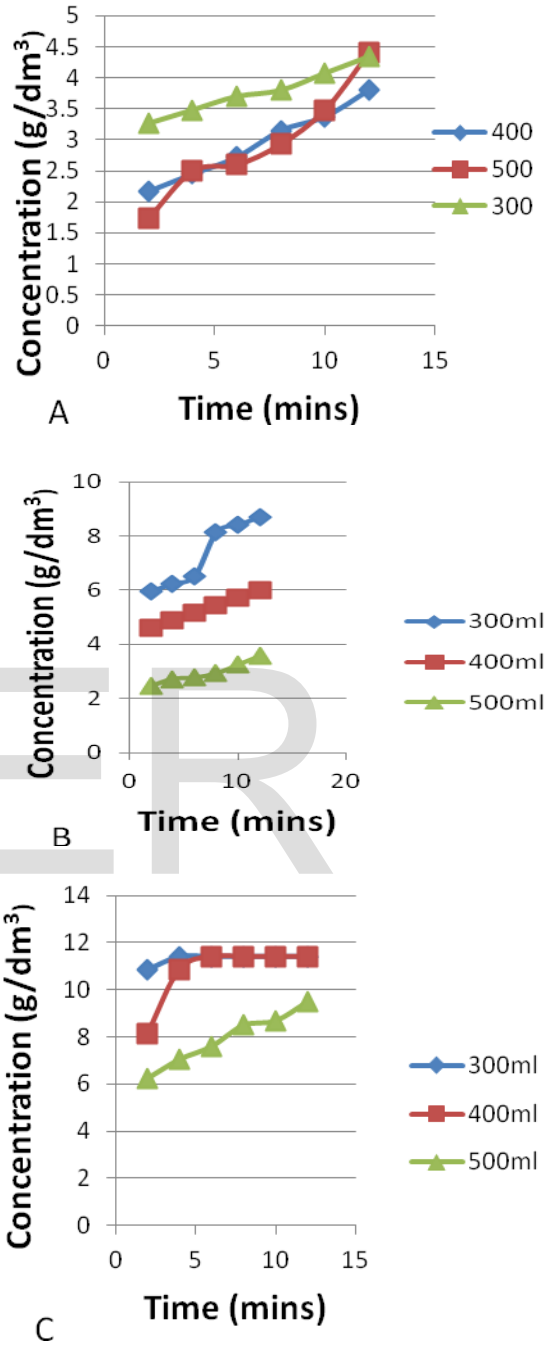

Fig.1. Concentration of Calyx at Different Volumes of Water for (A) 0.5g (B) 1.0g (C) 1.5g.

Fig.1 shows the concentration of calyx in varying volume of water at room temperature, the concentration increases with time as the diffusion rate increases. As the volume increases, it takes a longer time for the extract to diffuse through the

volume of water hence the extract diffuses through the 300ml of water faster than the others. In Fig. 1A it took 8 mins for 0.5g in the 300ml to reach a concentration of 3.8g/dm^3 and 12 mins for 0.5g in the 400ml to reach a concentration of 3.8g/dm^3. In the Fig.1C, for the maximum concentration of 11.41g/dm^3; it took the calyx in the 300ml 4 mins to reach this concentration and the calyx in the 400ml 6 mins to reach the same concentration. As time increased the concentration remained the same as seen in the Fig.1C, this implies that beyond these times further extraction would lead to waste of energy and time incurring more cost; thus to save cost, extraction should be stopped at these times. The concentration of the extract increased with increase in weight of calyx which is in line with the work done by Adogbo et al.,[11] where Roselle calyces were processed for high content anthocyanins and ascorbic acid.

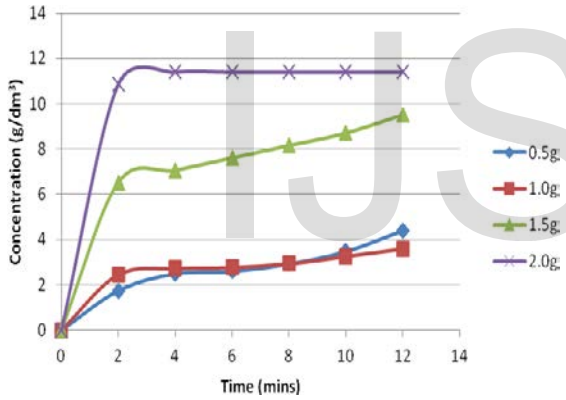

Fig.2. Concentration of Extract of Different Weights.

Fig.2. shows the concentration of the extract at a temperature of 80°C in 500ml volume of water. The concentration of the extract increased as the weight of the calyx bag increased, the 2.0g calyx bag gave the highest concentration. There is no significant difference between the 0.5g and 1.0g; they both have the same concentration of extract at 8 mins. The 1.5g shows a significant increase in concentration with time compared to the 0.5g and 1.0g but the 2.0g reaches maximum concentration of 11.41g/dm^3 at 4 mins after which the concentration remained constant indicating that no further extraction can be done beyond that time. The 2.0g of calyx gives the best result hence should be used since it gives its maximum concentration at a lower time thereby saving time and cost.

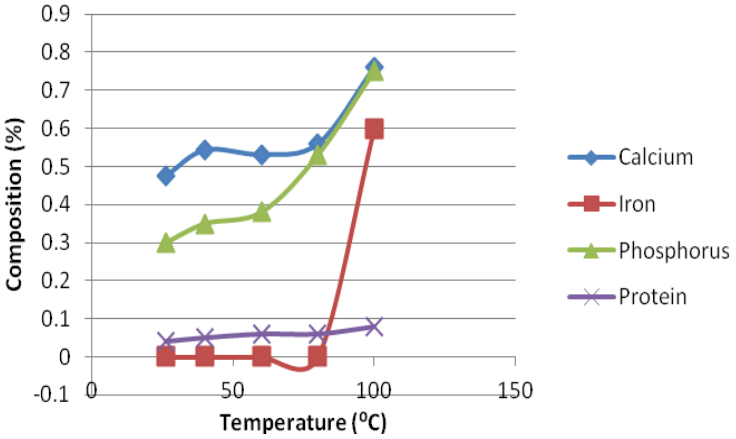

Fig.3. Composition of Calyx at Varying Temperature.

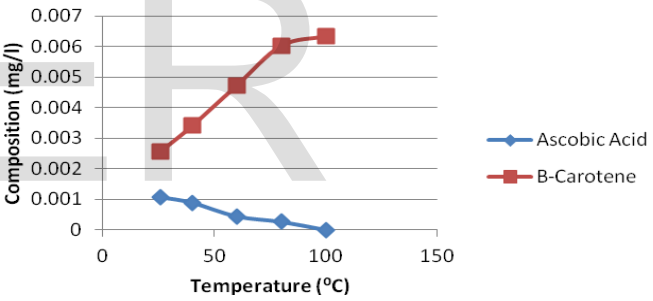

Fig.4. Composition of Ascorbic Acid and β-Carotene in Calyx.

The analysis in Fig. 3 and 4 were carried out using 1.0g of calyx in 400ml of water with increasing temperature of 26°C, 40°C, 60°C, 80°C and 100°C The Fig. 3 shows that the increase in temperature helps in releasing the minerals that are present in the calyx of *Hibiscus Sabdariffa*, calcium and phosphorus are important minerals that work together producing the compound calcium phosphate which gives strength and rigidity to bones and teeth, calcium reduces the risk of colon cancer thus the intake of *Hibiscus Sabdariffa* being processed at the right temperature would help medically. Iron is regarded as a trace mineral and is essential in blood circulation, forming red blood

cells and helps in carrying oxygen to the tissues but its release is favoured at a high temperature of 100°C or more. The release of protein is also favoured as temperature increases although in little quantities, the results gotten are in line with works that have been done by Bamishaiye et al.[14], Tounkara et al, [15] reported that boiling increases the concentration of almost all the mineral element present in roselle seed powder. The concentration of vitamin C (Ascorbic acid) decreases which is in line with the work done by Ranu et al.,[16] and Oyetade et al., [17] where ascorbic acid content decreased with increase in the temperature during processing. Beta-Carotene which is an essential pro-vitamin as it can be converted to active Vitamin A which serves several biological function is also seen to increase in yield as temperature increases. Nutrients in fruit drinks have been found to be less than that in the fresh fruit or calyces which can be as a result of the nutrient being denatured although some nutrients may not be completely soluble in water so it is possible that the nutrient was not completely released from the source of extraction.
Odebunmi et al. [18], reported that the Hibicus Sabdariffa drink is good for consumption at least within the first three days of production, the action of bacterial can affect the nutritional constituent in the drink.

4.0 Conclusion

The analysis carried out has shown that 2.0g of calyx per tea bag produces the most economic extract and is considered adequate for daily intake. Extraction done fresh from the calyx by infusion will help solve the problem of bacterial contamination and fermentation of the fruit drink as Habiscus Sabdariffa packaged in tea bags can be taken conveniently and without attendant health risks. Result have also shown that a temperature range of 60–70°C will favour the extraction process thereby preserving the nutrients present in the drink.

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