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PROXIMATE COMPOSITION AND MICROBIOLOGICAL QUALITY OF *ELUBO* PRODUCED FROM WATER YAM UNDER DIFFERENT TREATMENTS

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Abstract:
In this study, water yam was subjected to cold water and hot water soaking, thereafter; they were oven- dried at 60 °C for 72 h and ground to fine powder as elubo which was then subjected to proximate and microbiological analysis using conventional techniques. The results show that control sample had the highest moisture (8.79 %), protein (10.16 %), ash (1.66 %) and fibre (2.00 %) contents while hot water treated water yam flour had the lowest values of 6.72 , 9.89 , 1.49 and 1.87 % respectively for moisture, protein, ash and fibre content respectively. Although, the lipid and carbohydrate content were higher in the hot water treated sample which had 1.82 and 78.73 compared with the control which had 1.53 % and 75.86 % respectively for lipid and carbohydrate.. The microbial count on the three samples of elubo revealed that there was no significant (p, 0.05) difference in both the total bacterial and total fungal count of elubo made from both hot water and cold water treatments. However, the total bacterial and fungal count in the untreated sample (control) were significantly higher than the other samples. Three bacterial species (Staphylococcus aureus, Bacillus subtilis, Pseudomonas aeruginosa) and five fungal species (Saccharomyces cerevisiae, Rhizopus stolonifer, Penicillium italicum, Aspergillus niger and Geotrichum candidum) were isolated from the prepared elubo samples. This indicate that soaking treatment have no detrimental effect of the nutritional profile and microbiological quality of water yam flour and may be used in the preparation of elubo.

Keywords: Elubo, Water yam, Quality, Proximate, Microbiology

Introduction

Dioscorea species is a major staple food in Nigeria where it is cultivated in large quantity. It is a very popular food among Nigerians across all the social strata. Although, the crop is found throughout the tropics, most of the yams are produced in Africa (Udensi et al., 2010). Nigeria is the major producer of yam accounting for over 80% of the worldwide production, other countries where yam is produced on a large scale are Ivory coast, Ghana, Benin Republic and Togo, all in West Afrca (Abara et al., 2011).

Several yam species have been described from different part of the world; however, the major varieties with economic importance in Nigeria are *Dioscorea rotundata, Dioscorea cayenensis* and *Dioscorea alata*. *Dioscorea alata (water yam)* is one of the neglected crops according to Arinathan et al. (2009). Since it is highly perishable, its tubers may not be kept for more than a few months after harvesting. Moreover, the high level of water in *D. alata* as well as its fragile nature contributes to its low market value and acceptability in world market (Udensi et al., 2010).

Of a necessity, yam needs to be coverted into a more stable and easy to manage form which will improve its shelf-life thereby increaing its market value with attendant enhancement of food security. Yams are highly perishable and once harvested deteriorates quickly leading to loss of upto 50 % of the production (Udensi et al., 2010). This necessitates the development of strtegies to conserve this important source of food to make it available throughout the year. Various products are thefore produced from yam and yam flour popularly called *elubo* among the people of south west Nigeria is one of such

products. It is a flour made from the processed yam which is then made into thick paste whenever needed with minimal processing.

The production of *elubo* from fresh water yam after harvest is an efficient antidote against loss both in quality and quantity of yams. During the processing, the yam tubers are peeled and washed to prevent enzymatic browning and then cut into slices for drying. The dried yam is then pulverized into powder form (flour) followed by sieving using a mesh (Ekwu et al., 2005). The flour (*elubo*) is a stable material that can be stored for several months before use. *Elubo* is very popular among the Yorubas of the Southwestern Nigeria and it is prepared using various methods ranging from cold water treatment to high temperature treatment and fermentration. This study was therefore designed to assess the proximate composition and microbiological quality of *elubo* made from water yam using different processing methods.

Materials and Methods

Source of materials

The water yam was bought from Oja Oba in Owo, Owo Local Government Area, Ondo state, Nigeria. They were moved to the Biology Laboratory, Department of Science Laboratory Technology, Rufus Giwa Polytechnic, Owo for further experimental procedures.

Treatment of the yam sample

The water yam was peeled with a knife and then cut into small sizes and subjected to three different treatments.

A. 1 kg was soaked in cold water for 24 hrs
B. 1 kg was soaked in hot water (100 ^{o}C) and allowed to cool and left for 24 hrs
C. 1 kg was not soaked at all to serve as control

Thereafter, all the samples were oven-dried at 60 ^{o}C for 72 h until they reached a constant weight.

Determination of Proximate Composition

The moisture, ash, lipid, fibre, protein and carbohydrate content of the samples were determined using the method described by AOAC (2005).

Microbiological Assay

Isolation of bacterial species elubo sample

Nine milliliters of distilled water was pipetted into 6 clean test tubes each, covered with cotton wool and aluminum foil, and then autoclaved at 121 ^{0}C for 20 minutes. The sample was macerated in a beaker containing 10 ml of distilled water to make 1:9 of sample water ratio i.e. 10^{-1}. The mixture was shaken well to suspend the propagules then a sterile pipette was used to measure 1 ml from the supernatant into another test tube containing 9ml sterile distilled water. The mixture was shaken to homogenize this making 10^{-2}. This was done in sequential order until the last test tube 10^{-6}. About 0.1 ml of suitable dilutions was transferred aseptically in to Petri dishes and molten sterile agar (at 45 ^{0}C) was aseptically poured and the mixture was swirled gently to ensure even distribution of the inocula. The medium was allowed to set after which plates were inverted and incubated at appropriate temperatures.

Characterization and identification of isolates

To identify the isolates from pure cultures, plate characteristics as well as various biochemical tests were carried out. This was done according to the scheme of APHA (1998).

Statistical Analysis

The results are expressed as means ± SEM of three replicates. Data were subjected to one-way analysis of variance (ANOVA) using SPSS version 25.0. The Duncan's Multiple Range test was used to separate the means at the 5% level of probability

Results and Discussion

The results of the proximate composition of the three flours obtained from water yam is shown in Table1. The control sample had the highest moisture (8.79 %), protein (10.16 %), ash (1.66 %) and fibre (2.00 %) contents while hot water treated water yam flour had the lowest values of 6.72 , 9.89, 1.49 and 1.87 % respectively for moisture, protein, ash and fibre content respectively. Although, the lipid and carbohydrate content were higher in the hot water treated sample which had 1.82 and 78.73% compared with the control which had 1.53 and 75.86 % respectively for lipid and carbohydrate.

Table 1: Proximate composition of water yam flour (elubo) produced from three different treatments

Proximate	Cold water	Hot water	Control
Moisture	7.28±0.00^{a}	6.72±0.01^{a}	8.79±0.02^{b}
Protein	10.02±0.01^{a}	9.89±0.07^{a}	10.16±0.05^{a}
Lipid	1.59±0.10^{a}	1.82±0.00^{b}	1.53±0.00^{a}
Ash	1.58±0.02^{b}	1.49±0.00^{a}	1.66±0.00^{b}
Fibre	1.98±0.00^{a}	1.87±0.01^{a}	2.00±0.01^{a}
Carbohydrate	77.55±2.10^{a}	78.73±0.25^{a}	75.86±0.15^{a}

This study showed that the fat and ash contents for all the flours tested were higher than those that have been reported in the literature. i.e.: ash and fat contents in different varieties of *D. alata* 0.19 - 0.51 and 0.5- 0.73% respectively (Okorie et al., 2011). However, these differences can be expected due to varietal and geographical differences. High amounts of fat can be one of the reasons for the feeling of satiety once the flour of this cultivar is compared to other root and tuber crops such as cassava, potato and sweet potatoes. The high level of carbohydrate may be probably due to the presence of mucilaginous material in the starch of the yam. The higher ash content in the control sample suggests that soaking treatment may affect the mineral content of the yam flour. Ash content is the measure of the mineral content of food material. Literature reveals very low levels of minerals in Nigerian varieties of *D. alata* species (Udensi et al., 2008). Comparatively, there were no significant differences in the nutritional composition of water yam flour subjected to different soaking methods and the non soaked one.

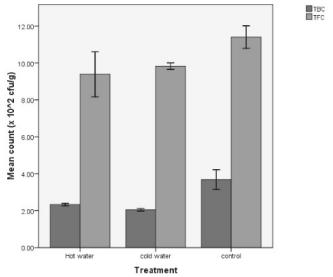

Figure 1: Microbial count on *elubo* produced from water yam under three different treatments

The microbial count on the three samples of *elubo* is shown in figure 1. The figure reveals that there was no significant (p, 0.05) difference in both the total bacterial and total fungal count of *elubo* made from both hot water and cold water treatments. However, the total bacterial and fungal counts in the untreated sample (control) were significantly higher than the other samples. This higher count in the untreated sample may be due to the better water activity in the untreated sample which made it a better growing medium for microbial species. Moisture content is directly linked with the survival of microbial agents in food (Achi and Akubor, 2000). Higher moisture content has been linked to quick deterioration leading to spoilage. Therefore, the untreated sample may be prone to fast spoilage due to the activities of microorganisms.

Table 2: Microbial distribution on *elubo* produced from water yam under three different treatments

Organism	Cold water	Hot water	Control
Staphylococcus aureus	+	+	+
Bacillus subtilis	+	+	+
Pseudomonas aeruginosa	-	-	+
Saccharomyces cerevisiae	-	-	+
Rhizopus stolonifer	+	-	+
Penicillium italicum	+	+	+
Aspergillus niger	+	+	+
Geotrichum candidum	+	-	+

Key: + = present, - = absent

Three bacterial species (*Staphylococcus aureus, Bacillus subtilis, Pseudomonas aeruginosa*) and five fungal species (*Saccharomyces cerevisiae, Rhizopus stolonifer, Penicillium italicum, Aspergillus niger* and *Geotrichum candidum*) were isolated from the prepared *elubo* samples. All these were found on the untreated sample whereas, only four were found in the sample treated with hot water while six were found in the sample treated with cold water.

The presence of *S. aureus* and *B. subtilis* on all the samples may be from environmental contamination as these organisms are ubiquitous in the environment and are normal flora of the human skin and soil respectively. *P. italicum* and *A. niger* were found on all the samples which suggests that they may be the major organisms responsible for the spoilage of the *elubo*. These two fungi have been implicated in the spoilage of several dry products such as cereals, flours, tubers and their products (Adeniran et al., 2013).

Overall, the three *elubo* samples were of high microbiological standard as the microbial counts were within the permissible range set by National Food and Drug Administration Commission (NAFDAC) for the type of food. Also, the absence of pathogens and toxigenic strains of organisms is a clear indication that the *elubo* samples are safe for consumption.

Conclusion

Based on the results obtained from this study, it can be concluded that different soaking methods had no detrimental effect on the nutritional profile and microbiological quality of water yam flour. However, hot water treatment seems to increase the lipid and carbohydrate content of the water yam flour as well as its microbial quality. But further studies concerning the phytochemicals and mineral constituents of these flours is needed to come to a more conclusive study

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