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EFFECT OF HEAT TREATMENTS ON PROXIMATE COMPOSITION OF SWEET POTATO TUBERS

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ABSTRACT

Sweet potato is an important member of root and tuber crops which serve as a carbohydrate source for large populace in many developing countries. Its tuber is subjected to various heat treatment processes in its conversion from the raw form into final products which can be readily consumed. This study investigated the effects of heat treatment methods on the proximate composition of processed sweet potato tubers. White- and yellow fleshed sweet potato tubers used for this study were sourced locally from Bodija market in Ibadan metropolis, Oyo State, Nigeria. The tubers were subjected to three common heat treatment methods namely boiling, roasting and frying. Sweet potatoes from each of the heat treatments were subjected to proximate analysis. The results obtained shows that the heat treatment methods did not have any significant effect ($p \leq 0.05$) on the carbohydrate content of both varieties. Boiling, on the other hand, had significant effect ($p \leq 0.05$) on the ash, fibre and fat contents while it had no significant effect ($p \leq 0.05$) on the moisture and protein contents of both varieties. Roasting had no significant effect on the fat content although it had significant effect ($p \leq 0.05$) on the ash, fibre, protein and moisture contents of both varieties. All the investigated heat treatment methods had significant effects ($p \leq 0.05$) on the crude fibre and ash contents of both varieties. All the heat treatment methods effectively retained most of the nutrients in the sweet potato tubers within acceptable limits for human consumption. However, frying resulted in increased fat content which is often recommended to be avoided by the medical practitioners and dieticians to avoid the attendant health risks. Boiling is recommended when products of higher moisture and protein contents are desired.

Keywords: Sweet potato, frying, roasting, boiling, proximate composition

1. INTRODUCTION

Sweet potato (*Ipomoea batatas)* is a dicotyledonous plant of the *Convolvulaceae* family. It originated in Latin America from where it was brought to Europe, Africa, India, China and Japan (Woolfe, 1992). It is cultivated in over 100 developing countries and ranks among the seven most important food crops in over 50 of those countries (Bhattiprolu, 2000; Okorie and Onyeneke, 2012). They come in variety of colors and sizes and is rich in vitamins, minerals, antioxidants, fiber and beta carotene. It is appreciated for its very high nutritional value found in the tubers and the young aerial parts which serve as vegetables (Kure *et al.*, 2012).

The tubers are prepared for immediate consumption or processed into various products such as flour, chips, flakes etc. Its flour is very useful in baking and making various confectionary. The processing operations to which the tubers are subjected depend on the desired end products. The unit operations in the processing of sweet potato tubers include peeling, washing, cutting, heat treatments, milling, packaging etc. Heat treatments such as drying, frying, roasting and boiling are among the important processing operations in sweet potato tuber processing (Chukwu *et al*., 2012). Knowledge of the effects of various heat treatment methods on the quality attributes of the tubers is very important to the consumers and the food industry at large. This study was therefore, designed to investigate the effects of selected heat treatment methods on the proximate composition of sweet potato tubers.

2. MATERIALS AND METHODS

2.1 Materials Acquisition

Yellow- and white-fleshed varieties of sweet potato tubers used for the study were purchased at Bodija market in Ibadan, Oyo State. The tubers were packaged in a well ventilated sack and transported to Agricultural and Environmental Engineering Processing laboratory for samples preparation.

2.2 Sample preparation

One hundred and sixty grams of each cultivar was manually peeled and cut into smaller pieces using a sharp stainless-steel knife and washed properly with clean water. The samples were prepared by boiling 40 g of each cultivar with 500 mL of clean water in an aluminum pot for 20 minutes, roasting 40 g of each cultivar using coal, coal pot and wire mesh for 8 minutes and frying 40 g of each cultivar using 300 mL of vegetable oil for 5 minutes using a stainless-steel non-stick frying pan while 40 g fresh (untreated) samples of both cultivars were used as the control.

2.3 Proximate analysis

Proximate analysis of the heat-treated samples was carried out at the Department of Human Nutrition Laboratory, University of Ibadan, Nigeria, The percentage moisture content, carbohydrate, crude protein, fat, fibre and ash contents of the sweet potato tubers were determined according to Association of Official Analytical Chemists Official methods (AOAC, 2000).

2.4 Data analysis

Data obtained from the laboratory analysis were subjected to analysis of variance (ANOVA) and statistical analysis using Statistical Analysis System (SAS) version 9.4.

3. RESULTS AND DISCUSSION

The results of the proximate analysis carried out on the heat treated white-fleshed and yellow-fleshed sweet potato tubers are shown in Table 1. The moisture content ranged between 42.54 and 68.19% which are within the range of values obtained by Bahado-Singh et al. (2006) and Gouado *et al.* (2011). Roasted yellow-fleshed (RYF) sample had the lowest moisture content value of 42.54±0.04 while fried white-fleshed (FWF) sample had the highest value of 68.19±0.02. Fresh yellow-fleshed (CYF, as control) and boiled yellow-fleshed (BYF) samples were not significantly different ($p \leq 0.05$), having values of 59.67±0.02 and 59.64±0.08 respectively. The moisture contents of fresh white-fleshed (CWF, as control) and boiled white-fleshed (BWF) samples were not significantly different ($p \leq 0.05$), having values 61.65±0.05 and 61.61±0.08 respectively. Comparing the results obtained in this study with those by Adepoju and Adejumo (2015) on three sweet potato varieties, the moisture contents of the raw and boiled sweet potatoes were not significantly different, having values 69.80% and 66.20% respectively, which are higher than the values obtained in this study. This showed that the boiled sweet potato when compared to the raw (fresh) tubers contains almost the same amount of moisture.

Table 1: Proximate Composition of Sweet Potato

Samples	Moisture Content (%)	Crude Protein (%)	Crude Fat (%)	Crude Fibre (%)	Ash (%)	Carbohydrate (%)
CYF	59.67±0.02^{c}	1.66±0.06^{d,e}	0.09±0.01^{d}	1.74±0.03^{f}	1.06±0.01^{e}	37.52±0.08^{a}
BYF	59.64±0.08^{c}	1.71±0.05^{d,e}	0.04±0.00^{e}	1.41±0.01^{g}	1.51±0.02^{d}	37.13±0.13^{a}
FYF	43.57±0.03^{e}	1.90±0.13^{d,c}	2.41±0.01^{b}	2.37±0.06^{c}	3.53±0.05^{b}	48.59±0.12^{a}
RYF	42.54±0.04^{f}	3.57±0.13^{a}	0.10±0.00^{d}	3.20±0.0^{b}	3.01±0.04^{c}	50.78±0.13^{a}
CWF	61.65±0.05^{b}	1.46±0.06^{e}	0.15±0.01^{c}	4.90±0.07^{a}	0.77±0.02^{g}	35.97±0.05^{a}
BWF	61.61±0.08^{b}	1.61±0.05^{e}	0.11±0.01^{d}	1.82±0.01^{e}	0.85±0.02^{f}	35.83±0.12^{a}
FWF	68.19±0.02^{a}	2.01±0.08^{c}	2.98±0.03^{a}	1.45±0.05^{g}	4.34±0.04^{a}	22.50±0.05^{a}
RWF	44.69±0.16^{d}	2.70±0.25^{b}	0.10±0.00^{d}	2.03±0.06^{d}	1.53±0.05^{d}	51.00±0.12^{a}

Note: Values within each sample of sweet potato marked by the same letters within same column are not significantly different (p>0.05).

CYF: Control Yellow flesh; BYF: Boiled Yellow Flesh; FYF: Fried Yellow Flesh; RYF: Roasted Yellow Flesh; CWF: Control White Flesh; BWF: Boiled White Flesh; FWF: Fried White Flesh; RWF: Roasted White Flesh

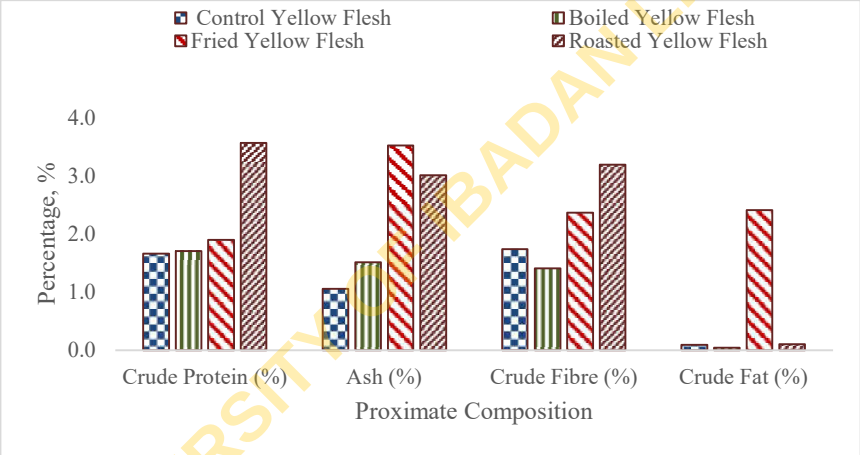

Figure 1-A: Proximate composition of Yellow-fleshed sweet potato

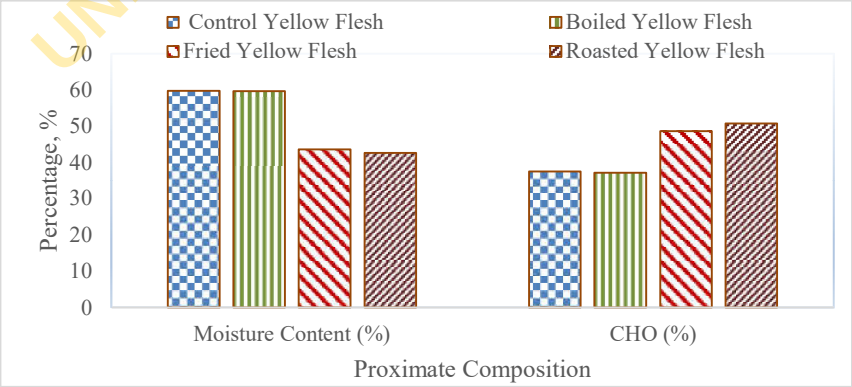

Figure 1-B: Proximate composition of Yellow-fleshed sweet potato

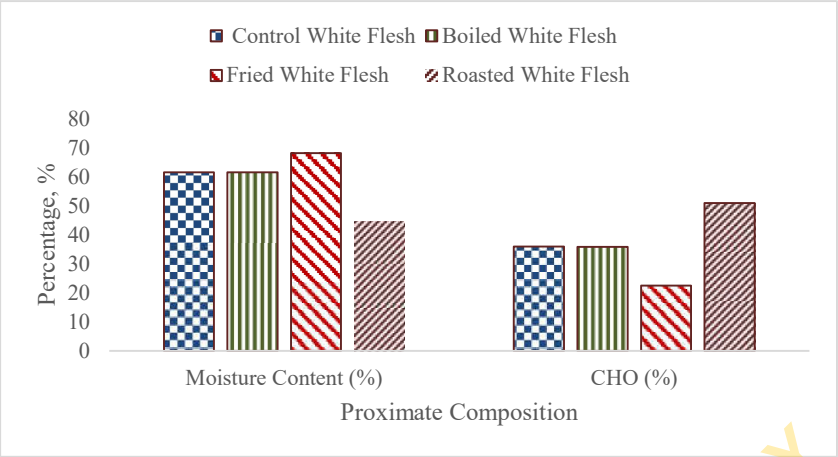

Figure 2-A: Proximate Composition of White-fleshed Sweet Potato

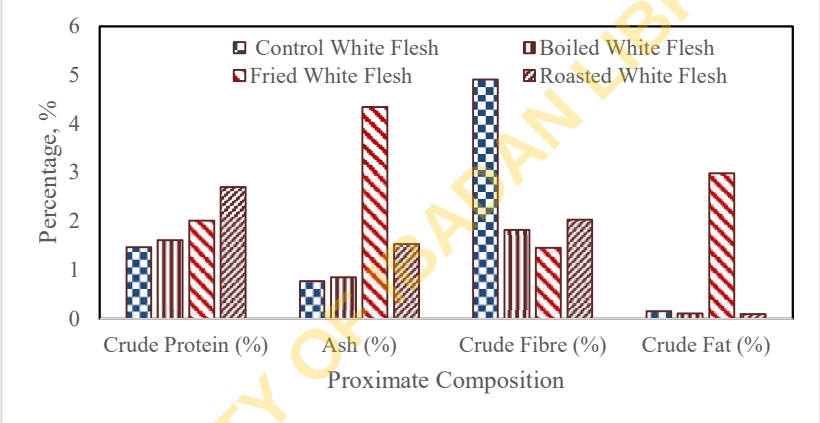

Figure 2-B: Proximate Composition of White-fleshed Sweet Potato

The crude protein obtained ranged between 1.46 and 3.57% with CWF having the lowest value of 1.46±0.06 and RYF having the highest value of 3.57±0.13. CYF and BYF were not significantly different ($p \leq 0.05$), with values 1.66±0.06 and 1.71±0.05 respectively. Also, CWF and BWF were not significantly different ($p \leq 0.05$) in moisture content, with values of 1.46±0.06 and 1.61±0.05 respectively. This showed that the boiled sweet potato tubers when compared to raw (fresh) samples contain almost the same amount of percentage protein. In a study conducted by Dincer *et al.* (2011), protein content of sweet potato ranged between 3.67 and 5.08% which is higher than the values obtained in this study.

The crude fat obtained ranged between 0.04 and 2.98% with BYF having the lowest value of 0.04±0.00 and FWF having the highest value of 2.98±0.03. CYF, RYF, BWF and RWF were not significantly different ($p \leq 0.05$) in fat content having values 0.09±0.01, 0.10±0.00, 0.11±0.01 and 0.10±0.00 respectively. Comparing these results to a study conducted by Akande *et al.* (2015), the fat content of heat-treated cocoyam flour ranged between 5.35 and 8.00% which is higher than the values obtained for sweet potato tubers in this study.

The crude fibre content ranged between 1.41 and 4.90% where BYF had the lowest value of 1.41±0.01 and CWF had the highest value of 4.90±0.07. BYF and FWF were not significantly different ($p \leq 0.05$), with values of 1.41±0.01 and1.45±0.05 respectively. When compared to the control sample, BYF and FWF reduced in fibre content. Also, when compared to a study conducted by Adepoju and Adejumo (2015), the fibre content of sweet potato ranged between 0.81 and 1.00% which is lower than the values obtained in this study.

The ash content ranged between 0.77 and 4.34% with CWF having the lowest value of 0.77±0.02 and FWF having the highest value of 4.34±0.04. BYF and RWF were not significantly different in ash content with values of 1.51±0.02 and 1.53±0.05. This compared to a study conducted by Ajala *et al.* (2014), the ash content of cocoyam flour ranged between 2.467 and 2.967% which is higher than the values obtained in this study.

The carbohydrate content varied between 22.50 and 51.00%. FWF had the lowest value of 22.50±0.05 and RWF had the highest value of 51.00±0.12. There were no significant differences ($p \leq 0.05$) in the total carbohydrate content of the samples when compared with the control samples. This is in agreement with the result obtained by Ikanone *et al.* (2014) where the carbohydrate content of sweet potato when boiled and fried were not significantly different ($p \leq 0.05$) from the control sample.

The carbohydrate contents of both varieties were not significantly affected by the heat treatment methods while other proximate compositions were significantly affected by, at least, one of the heat treatment methods.

4. CONCLUSION

The effect of selected heat treatment methods namely roasting, frying and boiling on the proximate composition of Nigeria-grown white- and yellow-fleshed sweet potato tubers was investigated in this study. All the investigated heat treatment methods had no significant effect on the carbohydrate content of both varieties. Boiling, on the other hand, had significant effect on the ash, fibre and fat contents while it had no significant difference on the moisture content and protein content of both varieties. Roasting had no significant effect on the fat content whereas it had significant effect on the ash content, fibre content, protein content and moisture content of both varieties. The heat treatments had significant effects on the crude fibre content and ash content of both varieties.

All the investigated heat treatment methods sufficiently retained most of the nutrients in the tubers after processing. However, frying resulted in increased fat content which is often recommended to be avoided by the medical practitioners and dieticians to avoid the attendant health risks. Boiling is recommended when products of higher moisture and protein contents are desired.

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