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EFFECT OF PROCESSING ON THE PROXIMATE, FUNCTIONAL AND SENSORY QUALITY OF PROCESSED WATER YAM FLOUR

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ABSTRACT

Water yam (Discoreaalata) being a seasonal and perishable crop, it is pertinent to convert it to flour in order to extend its shelf life and utilization. This project was aimed at investigating the effect of processing on the proximate, sensory and functional properties of water yam flour. Fresh water yam tubers were processed into flour using different methods (Water blanching, chemical blanching, sliced and dry; grate and dry). The flour was reconstituted to slurry and cooked with other ingredients to make (ikokore) using fresh water yam as control. The flour samples varied significantly ($p<0.5$) in terms of crude fibre and crude protein with values ranging from 1.53 to 2.15% and 9.28 to 9.71% for fibre and protein respectively. The highest value was recorded for flour obtained by (water blanching, grate and dry) while the flour obtained by (GD) has the highest value for crude protein. The moisture content ranged from 8.81 to 10.05%. The ash content ranged from 1.93 to 2.54% water blanched, sliced and dried sample has the highest ash content (WBSD) while grate and dry sample has the lowest value (GD). The functional properties analysis showed that the flour obtained by (GD) has the highest water absorption capacity. In terms of sensory the control sample has the highest general acceptability with the value 8.80 ± 0.52^a while the steam blanched-sliced and dried has the lowest value 6.00 ± 2.33^b.However, this study shows that the flour samples are ofgood quality when reconstituted for further usage.

Keywords: GD: grate and dry; WBGD: water blanched, grate and dry

INTRODUCTION

Water yam belongs to the family of (Discorea ssp.), and it is known to contain bio-activite compounds such as Discorine, Discogenin and water soluble polysaccharides. (Liu et al., 2007). Which play important role in management of hypertension Water yam (Discoreaalata), commonly called ten months yam, it is the most wide spread yam spices and more important as food in West Africa and Caribbean than in Asia and America, where it Originated and it has been competing with the most important native species. Water yam is an excellent source of starch which provides calorific energy and protein three times more superior than the ones of cassava and sweet potatoes. Water yam (Discoreaalata) is an important food crop produced in the Tropic mostly in African and Asia with tuber sizes varying from 2.5 kg – 5kg and vine length to 10 to 20 meters long (Kay, 2000). Although water yam is widely cultivated in the tropic, it originates from south East Asia before introduction to West African in the 16th century. Water yams are valuable source of carbohydrate to supply human needs for food, especially arid regions. Yam (Dioscoreaalata) has not been significantly processed commercially, only a small portion of the crop is processed traditionally which is particularly popular in Yoruba speaking area of West Africa (Ijebus') but less so in other parts of the continent. (Dioscoreaalata) always preferred for use in preparing portage such as 'Ikokore' mainly eaten by the Ijebu people of South-Western Nigeria and 'Ojojo' grated and fried water yam. The fermented yam flour 'elubo' is also produced traditionally by blanching, drying and milling yam (Dioscoreaalata) which when stirred in boiling water will form a thick brown paste known as 'amala'. The local consumers (especially from Oyo state area of Nigeria) like swallowing small hand cut of amala with preferred soup. (Hahn et al., 1987).Ikokore is usually produced by peeling yam (Dioscoreaalata) and grating which is then hand cut in boiled water for cooking and other ingredients like crayfish, pepper, palm oil, fish, and seasoning, are then added to it. Water yam being a seasonal and perishable crop it is pertinent to convert it to flour in order to extend its shelf life and utilization. The nutritional, properties of water yam flour and the influence of processing on these properties were evaluated. Water yam (Discoreaalata) was subjected to different processing methods to produce flour and also wide the consumption. The water yam was grate and dry, water blanched, chemical blanched, sliced dried and Grate and dry.

MATERIALS AND METHODS

Preparation of water yam into flour

The method of (Babajideet al., 2012) was used. Water yam tubers were washed with clean water to remove adhering soil and other undesirable materials. The tubers were then peeled using kitchen knives and sliced into sizes of 2cm to 3cm thickness. The slice of yam were blanched in water at 50°C for 10 minutes after which it was drained and dried at 60°C in a cabinet dryer for 72hrs. The dried yam slices were milled with a Fritch hammer mill and pass through a 250 um sieve to obtain the flour and stored in high density polyethylene bag at 3°C.

Functional properties

Water and oil absorption capacity

The method described by Sosulskiet al. (1997). Water/Oil absorption were determined by mixing 1g of sample with 10ml distilled water/vegetable oil for 30 seconds using a warring whirl mixer. The sample was allowed to stand for 30 minutes at room temperature and then centrifuged at 3000rpm for 30 minutes. The volume of the supernatant was read directly from the graduated centrifuge tube. Water absorption was expressed as the amount of grams of water absorbed pergram of sample, while the oil absorption was expressed as gram of oil absorbed per gram of protein isolate. Water and oil have densities of 1.0 and 0.92g/ml respectively.

Water and oil absorption capacity were calculated as follows:
W/OAC = (Volume of total water or oil added to the sample – Volume of free water or oil)/Weight of sample taken x 100

Swelling capacity

The swelling capacity was determined by the method described by Okaka and Potter (1997). 100mL graduated cylinder was filled with the sample to 10mL mark. The distilled was added to give a total volume of 50mL. The top of the graduated cylinder was tightly covered and mixed by inverting the cylinder. The suspension was inverted again after 2 minute and left to stand for a further 8 min. the volume occupied by the sample was taken after the 8th minute.

Gelatinization temperature

The gelatinization temperature was determined by shinde (2001). One gram flour sample was weighed accurately in triplicate and transferred to 20mL screw capped tubes. 10mL of water was added to each sample. The samples were heated slowly in a water bath until they formed a solid gel. At complete gel formation, the respective temperature was measured and taken as gelatinization temperature.

Determination of proximate analysis

The proximate compositions such as moisture, protein, lipids, ash content, crude fibre and carbohydrate were determined using AOAC standard methods (AOAC, 1995).

RESULTS AND DISCUSSION

Proximate composition of water yam flour

Table:1 shows result for proximate composition of water yam flour produced. There is significant difference ($p<0.05$) in terms of moisture, ash content and crude fibre. Proximate composition is important in determining the quality of raw material and often the basis for establishing the nutritional value and overall acceptance of the consumers (Butt and Batool, 2010).

The mean value for moisture ranged from 8.81 to 10.05%. The flour samples were significantly different ($p<0.05$) from each other. The flour sample obtained by water blanching, grating and drying recorded the lowest value while the flour sample obtained by grating and drying has the highest value. Moisture content is an indicator of shelf stability; increase in moisture content can enhance microbial growth which leads to deterioration of foods (Adejumoet al., 2013). The recommended safe level of moisture content during storage of flours or food powder is between 12 and 14% (Sanniet al., 2005; Standard Organization of Nigeria, 2004). However, the moisture content observed in this present study shows that the flour sample has a good keeping quality and can be stored for longer time.

The mean value for ash contents range from 1.93 to 2.54% while that of fat content ranged from 2.30 to 2.73%. The flour samples were significantly different ($p<0.05$) for ash. The flour obtained by water blanching slicing and drying recorded the highest value for ash

content while the flour obtained by water blanching, grating and drying recorded the highest value for fat content. The flour obtained by grating and drying, and the flour obtained by chemical blanching recorded has lowest value for ash and fat content respectively. Ash content is an indication of the mineral contents of food.
The crude fibre mean value ranged from 1.53 to 2.15% while that of crude protein ranged from 9.21 to 9.71%. There issignificant difference ($p<0.5$) in terms of crude fibre and crude protein. The processing method adopted resulted in the variation of crude fibre and crude protein as seen in the result. The highest value was recorded by the flour obtained water blanching, grating and drying for crude fibre while the flour obtained by grating and drying recorded the highest value for crude protein. The reverse was observed as the lowest value was recorded by the flour sample obtained from grating and drying for crude fibre while flour obtained water blanching, grating and drying has the highest value for crude protein.

The carbohydrate mean value ranged from 73.86 to 74.18%. There was no significant difference ($p>0.05$). The entire flour sample recorded high carbohydrate content. This result showed that the processing method employed did not adversely have effect on the carbohydrate content of the flour samples.

Table: 1 result for proximate analysis of fefferently processed water yam flour

Sample	Moisture(%)	Ash(%)	Crude fat(%)	Crude fibre(%)	Crude protein(%)	Carbohydrate (%)
A	8.81 ± 0.07^{a}	2.51 ± 0.46^{b}	2.73 ± 0.04^{a}	2.15 ± 0.03^{a}	9.57 ± 0.01^{c}	74.17 ± 0.18^{ab}
B	9.25 ± 0.05^{d}	2.54 ± 0.02^{c}	2.47 ± 0.04^{b}	2.07 ± 0.02^{b}	9.50 ± 0.02^{d}	74.31 ± 0.01^{ab}
C	9.61 ± 0.04^{c}	2.27 ± 0.05^{a}	2.30 ± 0.02^{c}	1.89 ± 0.03^{c}	9.28 ± 0.03^{e}	74.17 ± 0.04^{ab}
D	9.86 ± 0.06^{b}	2.22 ± 0.03^{d}	2.71 ± 0.06^{a}	1.67 ± 0.02^{d}	9.81 ± 0.35^{a}	73.86 ± 0.33^{b}
E	10.05 ± 0.03^{a}	1.93 ± 0.01^{e}	2.51 ± 0.11^{b}	1.53 ± 0.01^{e}	9.71 ± 0.04^{b}	74.18 ± 0.07^{ab}

A-Water blanched, grate and dry, **B-**Water blanched, sliced and dry, **C-**Chemical blanched, **D-**Sliced dried, **E-**Grate and dry

Functional properties of water yam flour

The result of functional properties of water yam flour is presented in Table 2. There was no significant difference ($p<0.05$) for water absorption capacity, oil absorption capacity and swelling capacity. The mean value ranged from 2.47 ± 1.00^{a} to 2.84 ± 1.00^{a}; 2.02 ± 1.00^{a} to 2.34 ± 1.00^{a}; 5.82 ± 1.00^{a} to 6.90 ± 1.00^{a}, while the flour sample were significantly different ($p<0.05$) in terms of gelation temperature. Functional properties determine the application and use of food materials for various food products (Adenekanet al., 2017). Functional properties of foods connote the physiochemical properties which govern the behaviour of protein in foods (Kinsella and Melachouris, 2009).

Water absorption capacity represents the ability of a product to associate with under conditions where water is limiting, for example dough and paste (Giamiet al., 1992). The highest value was obtained by the water yam flour obtained grating and drying while the flour obtained by slicing and drying has the lowest value. The decrease in water absorption capacity could be due to the loose association between amylose and amylopectin in the native granules of starch and weaker associative forces maintaining the granules structure (Adebowaleet al., 2005; Adebowaleet al., 2008).

The oil absorption capacity mean value of the flour sample ranged from 2.02 to 2.34%. However, the flour sample did not vary significantly. Oil absorption capacity is an important functional property in food systems. Non-polar amino acid side chain of protein can form hydrophobic interactions with hydrocarbon chains of lipid that can affect the oil binding capacity (Saetae and Suntornsuk, 2010). The flour obtained by water blanching, slicing and drying recorded the highest value while the lowest value was recorded for the flour sample obtained by grating and drying. The reduction in OAC could probably be due to the reduced ability of the flour to entrap fat to it's a polar end of its protein chain as a result of decrease in its protein content (Adeleke and Odedeji, 2010).

The mean value for swelling capacity of the flour sample ranged from 5.82 to 7.42%. There was no significant difference between the flour samples. Flour produced by chemical blanching has the highest value (6.90 ± 1.00^{a}) while the least value was recorded for the flour sample obtained by grating and drying (5.82 ± 1.00^{a}).High swelling capacity has been reported as part of the criteria for a good quality product (Achinewhuet al., 1998). The different processing conditions had an impact on the swelling capacity of the water yam flour.

The mean value for gelation temperature ranged from 72.20 to 80.60°C. The flour samples significantly ($p<0.05$) varied (Table 2). The water yam flour obtained by grating and drying had the highest value while the least value was observed in the flour obtained by water blanching, grating and drying. This result shows that the different processing treatment applied had effect on the gelation capacity of the flour samples. According to Ihekoronye and Ngoddy (1985), the gelatinization temperature of starch is distinctive for different amount of starches.

Table 2: Result for Functional properties of differently processed water yam flour

Sample	WAC	Oil Absorption capacity	Swelling capacity	Gelatinization Temperature
A	2.81±1.00^{a}	2.20±1.00^{a}	6.03±1.00^{a}	72.20±1.00^{c}
B	2.67±1.00^{a}	2.34±1.00^{a}	6.66±1.00^{a}	76.80±1.00^{b}
C	2.60±1.00^{a}	2.16±1.00^{a}	7.42±1.00^{a}	79.20±1.00^{a}
D	2.47±1.00^{a}	2.07±1.00^{a}	6.90±1.00^{a}	80.60±1.00^{a}
E	2.84±1.00^{a}	2.02±1.00^{a}	5.82±1.00^{a}	80.60±1.00^{a}

A-Water blanched, grate and dry, B-Water blanched, sliced and dry, C-Chemical blanched, D-Sliced dried, E-Grate and dry

Table: 3Result of Sensory evaluation for fresh water yam and differently processed water yam flour

Sample	Color	Taste	Aroma	Texture	Mouth feel	O/acceptability
A	6.85±0.48^{a}	8.70±0.57a	8.65±0.74^{a}	8.10±1.80^{a}	8.10±1.77^{a}	8.80±0.52a
B	5.90±1.99^{b}	5.00±2.51^{c}	5.65±2.32^{b}	6.55±1.90^{b}	5.80±2.19^{c}	6.00±2.33^{b}
C	6.05±2.06^{b}	5.85±2.10^{bc}	6.70±2.05^{b}	6.65±1.89^{b}	6.40±1.95^{bc}	6.15±2.30^{b}
D	6.55±2.03^{b}	5.75±2.04^{bc}	6.40±2.08^{b}	6.35±1.72^{b}	6.55±1.70^{bc}	6.80±1.79^{b}
E	6.80±1.50^{b}	6.65±1.98^{b}	6.50±1.76^{b}	7.20±1.45^{ab}	6.40±1.39^{bc}	6.65±1.66^{b}
F	6.15±2.13^{a}	6.40±1.93^{b}	6.75±1.74^{b}	6.95±1.87^{ab}	7.35±1.78^{ab}	7.05±1.39^{b}

A-fresh water yam, B-Water blanched, grate and dry, C-Water blanched, sliced and dry, D-Chemical blanched, F-Sliced dried, E-Grate and dry.

There is significant ($p<0.05$) in all the parameters evaluated. Sample A (fresh water yam porridge) was the most acceptable in terms of color, aroma, taste, mouth feel with mean value of 6.85,8.70,8.65, 8.10; while sample B (water blanched sliced and dried) has the lowest mean values.

Appearance and lumps formation

The beauty of eating ikokore is the appearance and formation of the lumps at appropriate quantity.'Ikokore' produced from samples A- slice and dried flour, B - Water blanched sliced and dried flour; D - Chemical blanched sliced and dried flour has similar properties (i.e lumps and appearance) to that of the 'Ikokore' produced from fresh water yam and also easy to reconstitute into slurry; they also exhibit the properties of fresh yam. Sample D (chemically blanched) has the most solid lumps when compared to the other samples.

CONCLUSION

This study shows that the different processing conditions had varying impact on the proximate, functional and sensoryproperties of water yam flour samples.This determines its application and uses as processed materials for various food products and also connote the physiochemical properties which govern the behaviour of protein in foods. The proximate composition result showed that the flour obtained by grating had the highest protein content; highest water absorption capacity and low moisture content which increase its keeping quality and also prolong the shelf stability. It is therefore concluded that water yam can be process into flour using grating and drying, water blanching-sliced and drying, and chemical blanching for convenient reconstitution to prepare water yam porridge (ikokore), easy transportation and also reduce the stress, cooking time as well as availability.

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