GSJ: Volume 8, Issue 8, August 2020, Online: ISSN 2320-9186
www.globalscientificjournal.com

CHEMICAL AND PASTING PROPERTIES OF FLOURS OBTAINED FROM THREE VARIETIES OF YAM

BY

MAKANJUOLA, Olakunle Moses AND AJAYI, Adebola.

DEPARTMENT OF FOOD TECHNOLOGY, FEDERAL POLYTECHNIC, P. M. B 50 ILARO, OGUN STATE, NIGERIA.

ABSTRACT

The chemical and pasting properties of yam flours obtained from three (3) Varieties of yam were examined using standard analytical methods. The results revealed significant differences ($p \leq 0.05$) in moisture, protein carbohydrate, pH, amylose and amylose pectin while fat, ash and energy do not show any significant difference. The moisture content ranged from 3.41 – 9.94%; Protein content ranged from 2.29 – 15.13%, Fat varied from 1.41 – 2.32%; Ash varied between 3.79 – 4.11%, crude fibre ranged from 2.13 – 2.86 % while carbohydrate content varied from 70.23 – 78.84 %. The pH ranged from 6. 15 – 6. 44 while energy values of 1487.62, 1490.65 and 1564.28 Kj / 100g were obtained for the flours of the three yam varieties. Also amylose contents ranged from 21.01 – 35.19% while amylopectin varied from 64.81 – 79.03 %. Peak Viscosity ranged from 4282.33 – 5582.33 BU, with the white yam flour having the highest peak viscosity value. The breakdown viscosity varied from 961.00 – 1549.33 BU (flour from water yam had the highest value). The trough values of the Yam flours ranged from 3147.00 – 4622.00 BU while the final viscosity varied from 4088.67 – 66.25.00 BU. The set back values recorded were 941. 33, 1522. 00 and 2002.00 form the flours with peak time of 5.34,5.14 and 5.21 minutes respectively. Pasting Temperatures of 79.16, 84.10 and 83.2 ^{0}C were obtained for the three yam flours. Therefore, understanding yam flour characteristics will further provide information for their end use quality.

Keywords: Chemical, Pasting, Properties, Yam Varieties Flours

Corresponding Author: Makanjuola Olakunle Moses Department of Food Technology, Federal Polytechnic P. M. B 50 Ilaro, Ogun State , Nigeria
E-mail:olakunle.makanjuola@federalpolyilaro.edu.ng
Phone Number: +2348037136605

INTRODUCTION

Yams are starchy staples in the form of large tubers annual and perennial vines grown in Africa, the American, the Carebbean, South Pacific and Asia. There are hundreds of wild and domesticated *Dioscorea Speecies*. (ITTA, 2009). Yams are grown extensively in Africa especially in West African with over 90% of the world's production coming from the areas called "the yam zone of Africa (ITTA 2009). Yams are important source of carbohydrate for many people of the sub-sahara region, especially in the yam zone of West Africa (Akissoe et al., 2013), and are the third most important tropical root crop after cassava and sweet potato (Onyeka et al., 2006).

Yam contributes more than 200 dietary calories per capital daily for more than 150 million people in West Africa and serves as an important source of income (Babakaleye, 2013). Varietal difference influences the quality of various traditional yam products (Akissoe et al., 2001). The nutritional value of yam varies greatly between different species and amongst varietiesof the same species. Variation are also subject to such factors, as cultivation methods, climate and soil characteristic age of maturity reached by the tuber at harvest, length of storage and the processing techniques (Nwackukwu, 2009). According to Wang et al., (2006),The cooking and processing characteristics of yams, the eating and storage quality of yam containing products will be greatly dependent on starch properties since starch makes up about 70 - 82% of yam tubers.

Yam flour is a fine powder made form processing of yam tuber. It is the major ingredient in making of Amala in Nigeria when reconstituted (Akissoe et al., 2003). Processed yam flours are less bulky and less delicate to handle and store, and less proneto storage losses than in fresh tubers (Ezeocha et al., 2014). Abiodun et al. (2013) studied the influence of soaking method on the chemical and functional properties of Trifoliate yam.(*Discorea Dumentorium*) while Adejumo et al. (2013) researched into the quality attributes of yam flour (Elubo) as affected by blanching water temperature and soaking time. Also, Amoe et al. (2014) worked on the physico chemical and pasting properties of starch extracted form flour yam varieties, Obadina et al.

(2014) studies the change in nutritional composition, functional and sensory properties of yam flour as a result of pre-soaking while the functional and pasting properties of lesser known Nigerian yams as a function of blanching time and pastides size was undertaken by Okorie et al., (2011). However the objectivesof this present work are to determine the chemical and pasting properties of yam flours obtained from three varieties of yam as this will leadto better understanding of that applications in food systems.

MATERIALS AND METHODS

Source of Materials: Three (3) Matured fresh yam cultivars were harvested from the Botanical Garden of the Department of Science Laboratory Technology of the Federal Polytechnic Ilaro, Ogun State, Nigeria. The three varieties are Bitter Yam (*Dioscorea Dumentorum*), Water yam (*Dioscorea Aluta*) and White yam (*Dioscorea retundata*). The yam tubers were transported to the laboratories of Food Technology Department for further processing and subsequent analyses.

SAMPLE PREPARATION

The yam tubers were washed, peeled with aid of stainless knives, sliced into 1cm size, blanched in hot water at 55^0C for 10 minutes, drained and then transferred in stainless trays into the Cabinet oven dryer dried at 85^0C for 4 hours. The dried yam slices (chips) were cooled milled into flour with hammer mill, sieved with 600µm mesh sieve to obtain powdery form flour. The flour obtained were packaged and sealed in low density, polyethylene bag, kept in ambient temperature prior to further analyses. All reagents and chemical used were of analytical grade.

ANALYTICAL PROCEDURE.

The moisture, ash, fat, crude, fibre, crude protein, carbohydrate were carried out using the standard analytical methods of AOAC (2010).

DETERMINATION OF AMYLOSE CONTENT:

The amylose content of the yam flour was determined based on the iodine calorimetric method of Iwuoha (2004). About 0.1g of the flour sample was solubilized with 1ml of 95% ethanol and 9ml of 1N NaOH and heated in a boiling water bath for 10 minutes. 9ml of distilled water was added to 1ml of the extract to make a total volume of 10ml. 0.5 of the diluted extract was pipetted into a beaker, 0.1ml of 1N acetic acid and 0.2ml Iodine solution (0.2g iodine + 20g potassium iodine in 100ml of distilled water) was added to develop a dark blue colour. The colour solution was madeup to 100ml with distilled water and allowed to stand for 20 minute to fully develop colour. The solution was Vortexedand its absorbance was read on a spectrophotometer (Helio Gamma UVG 121108, Thermo Electron Corporation; England at 620nm Absorbance of standard comamylose with known amylose concentration was used to estimate the amylose content in the sample as follows;

$$\% \text{ Amylose} = \frac{\% \text{ Amylose of Standard X Absorbance of sample}}{\text{Absorbance of standard}}$$

The amylopectin content was calculated as: 100- amylose content

The pH was determined by taking 2gm of the flour sample, homogenized with 20ml of distilled water. The pH value of homogenate was read using a pH meter and recorded.

Determination of Pasting Properties

The pasting properties of yam flour sample was determined by Rapid Visco Analyser (RVA – 4, Newport Scientific Australia) according to method described by Vangsawasdi et al., (2009). 3 g of yam flour was weighed into a dried empty canister, 25ml of distilled water was dispensed into the canister containing the sample. The mixture was thoroughly stirred and the canister was fitted into the RVA (Rapid Visco Analyser). The Slurry was heated from 50^0C to 95^0C with a holding time of 2minute followed by cooling was at a constant rate of 11.25^0C per minute with constant share rate at 1600rpm. The pasting profile was read on a computer connected to the Rapid Visco Analyser.

DATA ANALYSIS

SPSS Software package (SPSS 20.0 for windows SPSS inc.Chicago IL USA) was use to evaluate the data geneted. All analysis was performed in triplicates. Analytical variation was established through a one way analysis of variance (ANOVA). Data was reported as standard deviation ±, means were separated using Duncan's Multiple Range Test (DMRT) with a 0.05 level to determine the significance difference.

RESULTS AND DISCULSION

RESULTS

Table 1: Chemical Composition of Flour Made from Three Yam Varieties

Parameters	NBI	NAL	NWH
Moisture (%)	9.94±0.03^{a}	6.34±0.03^{b}	3.41±0.04^{c}
Protein (%)	2.29±0.13^{b}	15.73±0.03^{a}	15.53±0.07^{a}
Fat(%)	2.14±0.02^{b}	1.41±0.01^{c}	2.32±0.02^{a}
Ash%	3.97±0.03^{a}	4.11±0.02^{a}	3.79±0.02^{a}
Crude Fibre (%)	2.86±0.01^{a}	2.22±0.03^{b}	2.13±0.01^{b}
CHO (%)	78.84±0.02^{a}	70.23±0.03^{c}	72.88±0.03^{b}
Amylose (%)	21.01±0.45^{c}	28.50±0.01^{b}	35.19±0.03^{a}
Amylo Pectin (%)	79.02±0.01	71.50±0.11	64.81±0.02
Energy (KJ/100g)	1487.62±0.02^{b}	1490.65±0.03^{b}	1564.28±0.01^{a}
pH	6.15±0.04^{a}	6.44±0.02^{a}	6.38±0.03^{a}

Values of triplicates mean ± standard deviation with the significant different in ($P \leq 0.05$).

Key:

Sample NBI: Bitter Yam (*Dioscorea Dumenturun*)

Sample NAL: Water Yam (*Dioscorea Alata*)

Sample NWH: White Yam (*Dioscorea Rotundata*)

Table 2: The Pasting Properties of Flour Obtained from Three Varieties of Yam

Parameters	NBI	NAL	NWH
Peak Viscosity	4282.33±4.16	4802.67±2.52	5582.23±2.52
Trough	3147.00±2.00	3254.67±1.53	4622.00±2.00
Break down viscosity	1132.67±2.52	1549.33±1.53	961.00±2.00
Final Viscosity	4088.67±1.53	4776.67±1.15	6625.00±2.00
Set back	941.33±1.53	1522.00±2.00	2002.00±2.00
Peak time (mins)	5.32±0.02	5.14±0.03	5.21±0.02
Pasting Temp (0^oC)	79.16±0.03	84.10±0.02	83.20±0.01

Values of triplicates mean ± standard deviation with the significant different in ($P \leq 0.05$).

Key:

Sample NBI: Bitter Yam (*Dioscorea Dumenturun*)

Bample NAL: Water Yam (*Dioscorea Alata*)

Sample NWH: White Yam (*Dioscorea Rotundata*)

DISCUSSION

The Chemical analyses of flours obtained from three varieties of yam are as shown in Table 1. The moisture contents were 9.94%, 6.34% and 3.14% for Bitter yam flour, water yam flour and white yam flour respectively signifying significant differences ($P \leq 0.05$) among the flour samples. Bitter yam (*Discorea Dumentatum*) had the highest moisture content while white yam (*Discorea Rotunda*) has the least value. High moisture contents in foods like flour is an indication that the product can not be kept for a long period of time before microbiological degradation set in as observed by Ezeocha and Okafor (2016). However, all the flour samples have moisture contents below 13%, which is the standard for dry foods reported by Prinya wiwatkul et al. (2007). The result of the moisture content was in agreement with the study of Jimoh and Olatidoye (2009) on the evaluation of physico-chemical and rheological characteristics of soyabeans fortified with yam flour.

Significant difference ($P \leq 0.05$) exists in the protein contents of the flour samples. Flours obtained from water yam and white yam flours have 15.73% and 15.53% Protein contents while bitter yam had 2.29% protein content. The variation in the protein contents of the flour samples may be due to genetic composition of the varieties as well as the environmental conditions as reported by Ukadukwu and Obioha (2000). The results also revealed significant differences ($P \leq 0.05$) in the fat contents of the flour samples. It ranged from 1.41 – 2.32% for the samples. Flour obtained from white yam had the highest value of 2.32% while flour from water yam had the least value of 1.41%. Furthermore, the ash contents ranged from 3.79% - 4.11% for the flour samples. The insignificant difference obtained in the crude fat contents were in agreement with a previous work of Adejumo et al. (2013) on the quality attributes of yam flour (Elubo) as affected by blanching water temperature and soking time.

Significant differences ($P \leq 0.05$) exist in the crude fibre of flours obtained from the three varieties of yam, ranging from 2.13 – 2.86%. Crude fibre aid in lowering the blood choleslterol, level and slows down the process of absorption of glucose, thereby helping in keeping blood glucose level in control. The carbohydrate contents made of starches represent the highest nutrient contents in yam. It ranged form 70.20 – 78.84%, indicating significant differences among the flour samples obtained from the three varieties of yam.

Amylose and amylopectin ratios are one of the important parameters reported to contribute to good textural attributes of root and tuber crops (Ikegwu e t al., 2009). Flour obtained from white yam had the amylose content of 35.19% while that of bitter, had the least value of 21.01%. The amylopectin of the flour samples are 79.02%, 71.50% and 64.81% for flours produced from bitter yam, water yam and white yam respectively, indicating significant differences ($P \leq 0.05$). However, the general low content of amylose of the flour of bitter yam indicates that when this flour is incorporated into food products, swelling of starch will be greatly enhanced (Testa and Morrison, 2009). Also, the difference in amylose content could be attributed to differences in the cultivars (varieties). The high content of amylose in the white yam may suggest possible use in the manufacture of noodles.

Significant difference ($P \leq 0.05$) also exist in the energy values obtained for the flour samples. It ranged from 1487.62 to 1564.28kj/100g. Yams generally are known to be a good source of energy irrespective of the variety. The metabolizable energy value of 1413kg/100g and 1360kg/100g calculated in a similar work by obadina et al. (2014) showed that yam is a concentrated source of energy within the recommended dietary allowance for adults. There are no significant differences ($P \leq 0.05$) in the pH values of the flour samples irrespective of the variety of yam.

Table 2 showed the result of the pasting properties of the flours samples. Pasting properties are important functional characteristics of starches. When an aquesous suspension of starch is heated above a critical temperature, granues swell irreversibly and amylose leaches out into the aqueous phase, resulting into increased viscosity (Pasting). It also gives an indication of the gelatinization time during processing (Odedeji and Adeleke, 2010). The peak viscosity of the flour sample under considerasion ranged from 4802.67 – 5582.33BU. These values are higher when compared with the results of Amoo et al. (2014) in which peak viscosity of 639 – 72634 was recorded from yam starches. Trough values of 3147.00, 3254.67 and 4622.00 were recorded from the flour obtained from the varieties of yam viz bitter yam, water yam and white yam respectively. The breakdown viscosity measures the ability of starch to withstand collapse during cooling or the degree of disintegration of granules or paste stability (Jimoh and Olatidoye, 2009). It was observed that flour from water yam had the highest breakdown value of 1549.33 BU, followed by bitter yam with the value of 1132.67 BU while white yam recorded the least value of 961.00BU. The final viscosity as shown in Table 2 revealed that flour samples from white yam had 6625.00 BU, 4776.67BU and 4088.67BU for bitterr yam. Set back measures the re-associateion of starch granues (Jimoh and Otatidoye, 2009). The setback values ranged from 941.33 to 2002.00 BU. These values were higher than those obtained in a previous work undertaken by Arian et al. (2010) for sorghum, and Amoo et al. (2014) for yam starches. However, low set back values are useful for products like wearing food, which require low viscosity and paste stability at low temperature (odura et al., 2001). The peak times in minutes are 5.34, 5.14 and 5.21 for flours of bitter yam, water yam and white yam respectively. Pasting temperatures for the flour samples ranged from 79.16 – 84.10^{0}C. These values compares favourably with those reported by Amoo et al. (2014) in which pasting temperature of yam starches ranged from 75.1 to 77.3 ^{0}C

CONCLUSION

The research has shown that yams, being a starchy food can be used industrially in the preparation of other products, such as weaning foods, noodles etc, thereby expanding its utilization while also minimizing post harvest losses, hence increased earnings from the crop.

REFERENCES

Abiodun, O. A, Akinoso, R, Oladapo, A. S and Adepoju, A. B (2003). Influence of soaking methods on the chemical and functional properties of Tripoliate Yam (Dioscorea Dumatorun) Flour. *J. Root crops. 39 (1) :84 – 87*

Akiossoe, N. H, Hounhooigan, J. D Mestres, C and Nago, M. C (2003). How Blanching and Drying Affect the Colour and Functional Characteristics of Yam (*D. Cayanesis-Rotundata)* Flour. *Food Chemistry: 82: 257 – 264.*

Akiossoe, N. H, Hounhooigan, J. D, Bricas, N, Vernier, P, Nago, M. C and Olorunda, O. A (2001). Physical, Chemical and Sensory Evaluation of Dried yam (*Diocorea Rotundata)* Tubers, Flour and Amala- A flour Derived Product. *Tropical Science: 41: 151 – 156*

Amoo, A. R, Wireko-Manu, F. D and Oduro, I. (2014). Physico-Chemical and Pasting Properties of Starch Extrated From Four yam Varietites. *Journal of Food and Nutrition Science. 2 (6): 262 – 269*

AOAC. (2010). Association of Official Analytical Chemists Officaial Methods of Analysis. *18th Edition, Washington D. C. USA.*

Aviara, N. A, Igbeka, J. C and Nwokocha, L. M. (2010). Physicochemical Properties of Sorghum (Sorghum Bicolar L. Moench) Starch as Affected by Drying Temperature Agricultural Engineering International. CIGR *E-Journal. 12:67- 74*

Babalaeye, T. (2003). Raising the Status of the Yam, A Major Food Crop in West Africa. ANB BIA Supplement Issue/ *Edition. 46 (3): 1-3*

Ezeocha, C. V and Okafor, J. C (2016). Evaluation of the Chemical, Functional and Pasting Properties of Starch from Trifoliate Yam (Dioscorea dumenturan) Landraces. *European Journal of Advance Research in Biological and Life science 2 (4): 27 - 33*

Ezeocha, V. C, Oti, E, Chukuruma, S. C, Aniedu, C and Eke-Okoro, O. M (2014). Evaluation of the Physicochemical Properties of Twelve D. Rotunda Landraces Grown in South-East Agro-Ecology. *Advance in Applied Science Research. 5 (3)21 – 25*

IITA (2009). Yam Production in Africa. International Institute of Tropical Agriculture (IITA), Nigeria. Available from http://www.iita.org.yam

Ikegwu, O. J , Nwobasi, N, Odoh, M. O and Oledinma, N. H (2009). Evaluation of the pasting and Some Functional Properties of Starch from Some Improved Cassava Varieties in Nigeria. *African Journal of Biotechnology. 8(10): 2310 – 2315.*

Iwuocha, C. I (2004). Comparative Evaluation of Physicochemical Wualities of Flour From Steamed-Processed Yam Tubers. *Journal Food Chem. 85:541-551*

Jimoh, K. O and Otatidoye, O. P (2009). Evaluation of Physicochemical and Rheological Characteristics of Soya beans Fortified with Yam Flour. *J.Applied Biosciences. 13:703-706*

Nwackukwu, E. C (2009). Filled Evaluation of 24 Top Hybrid Yams in Umudike and Otobi. *Proceeding of the 45th annual conferences of the Agricultural Society of Nigeria, Abuja. Pp 88- 90.*

Obadina, O. A, Babatunde, B. O and Olotu, I. (2014). Changes in Nutritional Composition, Functional and Sensory Properties of Yam Flour As a Result of Pre Soaking. *Nigieria Food Science and Nutrition. 2(6) : 676 - 681*

Odedeji, J. O and Adeleke, R. O (2010). Pasting Characteristics and Wheat amd Sweat Potato Flour Blends. *Paskistan Journal of Nutrition. 9 (6) : 555 – 557*

Oduro, I, Ellis, W. O Nyarko, L, Koomson, G and Otoo J. A (2001). Physicochemical and Pasting Properties of Flour from Sweat Potato Varieties in Ghana. *Proceeding of the Eight*

Triennial symposium of the International Society for Tropical Root Crops (ISTRC – AB) Ibadan, Nigeria. Pp 12 – 16.

Onyeka, T. J Petro, D, Ano G, Etienne, S and Reubeans, S. (2016). Resistance and Water Yam (Dioscorea alata) Cultivals in the French West Indies to Anthraxnose Diesease Based on Tissue Culture Derieved whole-plant Assay. *Plant Pathology 55: 671-678*

Prinyawiwatkul, W, Beuchat, L. R, McWatters, K. H and Phillips, R. D (2007). Functional Properties of Cowpea (Vignaunguiculata) Flour as Affected by Soaking, Boiling and Fungal Fermentation *J. Agric. Food Chem. 45:480 – 486*

Tester, R. F and Morrison, W. R (2009). Swellingand Gelatinization of Cereal Starches; Effect of Amylopectin, Amylose and Lipids. *Cereal Chemistry 67: 551 – 559*

Vongsawasdi, P, Noppharat, M, Hiranyaprateepm N and Tirapong, N (2009). Relationship Between Rhological Properties of Rice Flour and Quality of Vermicelli. *Asican J. Food Agric Ind. 2 (02): 102 – 109*

Wang, S, Liu, H, Gau, W, Chem, H, Yu, J and Xiao, P (2006). Characterization of New Staches Seperated from Different Chinese Yam (Dioscorea Opposite Thunb) Cultivars. *Food Chemistry. 99 : 30 – 37*