Swift Journals 2062-2684

Swift Journal of Agricultural Research
Vol 1(5) pp. 049-059 October, 2015.
http://www.swiftjournals.org/sjar


*Original Research Article*

# Physico-Chemical Composition of Starch from Five Landraces of Yam in Niger State.

**Tsado* E.K.**

Department of Crop Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State

Accepted 6th October, 2015.

**Yam (*Dioscorea* spp.) is the second most important root and tuber crop in Africa after cassava. This study was conducted to determine the relationship between physicochemical properties of yam starch (amylose and amylopectin, swelling, solubility and water binding capacity) and the textural quality (stretchability, cohesiveness, adhesiveness, hardness) of pounded yam, a major food product in West Africa. Yam starch was extracted from six tubers each of *Dioscorea alata* and *D. rotundata* and their physicochemical properties were determined by standard methods. Pounded yam was prepared from the same set of tubers. Textural quality evaluation was conducted on the pounded yam samples by sensory texture profiling. Data generated were evaluated by canonical correlation analysis. Results showed that *D. rotundata* with high swelling power, low amylose and water binding capacity gave pounded yam samples, which were cohesive, stretchable, moderately soft and less sticky compared to *D. alata* with high amylase, water binding capacity and low swelling power that gave pounded yam samples, which were very soft, unstretchable, sticky and in cohesive. Canonical analysis showed significant associations (P<0.05) between the physicochemical properties and textural quality of pounded yam samples. These results from *D. rotundata* were further validated using eighteen other randomly selected yam landraces from this yam species. The reproducibility of physicochemical parameters for the assessment of food textural quality was established. Thus, they can serve as indicators of food textural quality in the selection of yam for food quality by breeders and processors.**

**Keywords:** Yam starch, pounded yam, food quality, textural quality, physicochemical properties, D*. rotundata,*

## INTRODUCTION

Yam is the common name for a plant in the Genus Dioscorea (Family *Dioscoreacea*). The perennial herbaceous vines cultivated in Africa, Asia, Latin America and Oceania. It is cultivated for consumption because of its high starchy tubers. It may be served as a texturizing, thickening, or stabilizing agent. Other uses of Yam starch have not been of any significant commercial substance other than for food - such as pounded yam (yam dough), fried yam, boiled yam, roasted yam and porridges. (Amani *et al,* 2002).

Yam is one of the comparatively few crops of West African origin that entered into European language from the Mande tribe of West Africa. The word was adapted into Portuguese as “ynhame” and into Spanish as “name”, in French as “igname” and in English as “yam”. Yam tuber is a tropical crop used as a carbohydrate energy-rich staple food, mainly in West Africa, where more than 90% of the world’s yam is produced (FAO, 2004). The dry matter content of yam tubers varies between 20 and 40%, which in turn consists of 60–80% starch depending on variety; the duration of environment and the condition of pre and postharvest storage. Yam tubers can be stored for several months, but sprouting causes a considerable reduction in dry matter and water content of tubers. The use of the hormone Gibberellic acid ($GA_3$) and regular de-sprouting are effective treatments for reducing postharvest losses of yam (Girardin, *et al* 2003).

Starch is the most important thickening and gelling agent in most foods. Compared to potato and cassava starch- the two most commercialized tuber starches, the utilization of yam starch is limited, (Freital, *et al* 2008**).** A little comprehensive review of the properties of yam starch had given (Hoover, 2001). Expanding studies in the area of yam starch mean that additional uses can be proposed for yam starch hence the yam

**Corresponding Author:* Tsado* E.K., Department of Crop Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State
*E-mail:* ektsado@yahoo.co.uk

crop. The greatest amount of yam production today is in West Africa (Otoo and Asiedu, 2009).

***Problem Statement***

Attempt to resolve the problems of production of tuber crops for their starch content have placed more emphasis on increasing the production of such crops with greater quantity of starch content which is of various use to man. Hence, the need for "differences in starch content of these seven Yam (*Dioscorea spp* ) landraces grown in Niger state Nigeria.

***Justification of the Study***

The Cultivation of best landraces of yams which have the best quality needed by the farmers in Niger state to improve the production of yam flour also means additional food availability in the chain that may result in the provision of good nutrition for consumers.

**AIM OF STUDY**

The aim of the study is to recommend the best yam material based on its starch content.

***The Principal Objectives of the Study are to***

- To determine the starch content of seven different yam landraces of the state.
- To determine similarities in the nutritional value of the landraces.
- To make appropriate recommendations on the production of the best qualities of landraces.

**MATERIALS AND METHOD**

The study involved laboratory work conducted at Gidan Kwanu campus of Federal University of Technology, Minna, Niger state.

***Source of Tubers Used in the Study***

**.**

Seven landraces of yam tubers were used for this study. The landraces were Kwase – true name Habankwase, Giwa, Pepa, Yangwode, Amy; Didiyan, and Kpako (the last two are early yam cultivars). All yam landraces were obtained from the local yam market at Garatu in Niger State. They were transported to the laboratory of the Crop Production Department, School of Agriculture and Agriculture Technology, Federal University of Technology, Minna, Niger State. The following parameters were collected for each of the landraces, using the method described by AOAC (2000).

The following were collected:

Starch content; Crude protein; Ash content; Lipid; Moisture content; Soluble solids content; TitraTable acidity; Water activity; Salinity and pH.

***Preparation of the Samples***

The preparation of the yam specimens followed the under listed flow chart (Fig. 1)

***Isolation of Starch Content***

The yam tubers were peel and washed. They were then washed then cut into three sections: the proximal part (head of tuber ), the median part and the distal part (tail of tuber ). They were then sliced into small pieces. They were then weighed to get five hundred gram (500g).

of each of the yam landraces, and they were blended using electrically operated blender by adding 1000ml of distilled water for the grinding operation, immediately after grinding it was then sieved using manual sieve and also sieving another 1000ml of distilled water to make sure all the starch are sieved away from solid fibrous residue, it was then allow the starch to settle for about 20 minute, then the water was decant remain the starch, 200ml of distilled water was added and stir, it was allow the starch to settle and decant, it was done four(4x) and allow to dry under sun, after drying it was weighed and percentage starch was calculated.

$$\text{Starch \%} = \frac{Weight\ of\ starch}{Weight\ of\ tuber}\ x100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (Equation\ 1)$$

***Proximate Analysis***

All the parameters collected under this section were determined using the macro Kjeldahl method as described by AOAC (2000)..

***Protein Determination***

Protein content was determined using the macro-Kjeldahl method as described by AOAC (2000).. 0.5g of sample (dried) were weighted into 500ml Kjeldahl flask; 20ml of concentrated sulphuric acid was then added gently to each of the samples in the flask and it was heated on a heating block starting with a low heat about 200$^{o}$C for 30 minutes and it was swirl or by shaking the Kjeldahl flask Occasionally to mix and dissolve well. The temperature was increased to about 335$^{o}$C and was heated for about 5-6 hours to obtain a clear digest (complete digestion).

Then it was switched off and allowed to cool, and diluted with 100ml of distilled water. 10ml of boric acid was added into 100ml collection flask with 3 drops of mix indicator and placed under the collection spigot of the distillation apparatus. 10ml of the digest was pipette into the micro-distillation apparatus and 10ml of sodium hydroxide was added gently into the micro-distillation apparatus to react with the sample. The solution was allowed to distill for about 8 minutes or when the volume of ammonia collected in boric acid in the receiver flask was 50ml and the purple has turned solution green in colour. The distilled was titrating against 0.1N hydrochloric acid to give a reddish look colour. A blank titration was carried out and percentage protein was calculated.

$$\text{\%N} = \frac{T\ X\ M\ X\ 0.014\ X\ \frac{V1}{V2}}{W}\ X100 \ldots\ldots\ldots\ldots (Equation\ 2)$$

%crude protein=Nitrogen x 6.25
Where: T=Actual Titre Value.
M= Molarity of the Acid used.
W= Weight of sample digested.
V1= Volume of digest.
V2= Volume of digest distilled.

***Ash Determination***

Ash content was determined according to the method described by AOAC (2000).. The weight of the crucible was determined. 2g of the sample were added to each of the

crucible. The dish and content were placed on the furnace and the furnace temperature was set to 600°C for 3 hours (until the sample were completely turned to ashes). The dish was removed and kept in a desiccator to cool and percentage ash was calculated.

Ash content %= $\frac{W3 - W1}{W2 - W1} \times 100 \ldots\ldots\ldots\ldots (Equation\ 3)$

Where: W1= Weight of crucible.
W2= Weight of crucible plus sample.
W3= Weight of crucible ash.

***Lipid Determination***

Lipid content was determined using the Soxhlet solvent extraction method outlined in AOAC (2000).. The weight of an empty filter paper was taken. 2g of the sample were weighed and they were wrapped with filter paper and they were dropped into the extractor. Extraction was carried out using petroleum ether (boiling point 60°C - 70°C). The extraction was continually done for 8 hours. The lipid residue was dry in the oven at the temperature of 105°C for 10 minutes (until the sample were completely dry) and transfer then into the desiccator and cool for 15 minute, then the sample were weighed and percentage lipid was calculated.

Lipid content %= $\frac{W2 - W3}{W2 - W1} X100 \ldots\ldots\ldots\ldots (Equation\ 4)$

Where: W1= Weight of filter paper.
W2= Weight of filter paper plus sample.
W3= Weight of filter paper plus dry sample.

***Moisture Content of Tuber Determination***

The tubers were cut into three pieces and giving three lot of yam constituted of the proximal part (head of tuber), the median parts and the distal part (tail of tuber). And they were sliced into small pieces with knife and 20g of each yam cultivar lots was weighed, and it was put in the oven dry for three days, after dry it was weighed and percentage moisture was calculated.

Moisture %= $\frac{Loss\ in\ weight}{Original\ weight} x100 \ldots\ldots\ldots\ldots (Equation\ 5)$

***Moisture Content of Starch Determination***

This was determined according to the method described by AOAC (2000).. The weight of an empty, dry Petri dish was taken. 20g of the sample were added to it, using electrical weighing balance, the sample were dry in the oven at a temperature of 105°C for 20 hours (until the sample were completely dry) and transfer the Petri dish containing the sample into the desiccator and cool for 15 minutes, the weight of sample were taking immediately after cooling. And percentage moisture was calculated.

Moisture %= $\frac{Original\ weight - loss\ in\ weight}{Original\ weight} x100 \ldots\ldots\ldots\ldots (Equation\ 6$

***Determination of pH***

The pH of the sample was determined according to the method described by AOAC (2000).. 1g of the sample were weighed into a beaker containing 10ml of distilled water and allowed to stand for 30 minutes with occasional stirring. The pH is then determined by using an electrical pH meter

***Salinity Determination***

Digital refractometer was used to establish salinity of the sample, and 3 drops of the sample were placed on the prism to determine the concentration of salinity in each sample.

***Sensory Evaluation of the Yam Landraces Variety***

The variety was evaluated for their changes in colour, it was observed that there were significant difference in the colour of the Yam landraces, by 20 judges as described by Adeji Kehinde Kafilat (2010). The samples were evaluated on a grading scale of 1-4 (1-very white, 2-white, 3-light brown and 4-milky brown).

***Data Analysis***

All the data collected in the course of this study were subjected to statistical Analysis. When the Analysis of variance test was observed to be significant (p = 0.05), the least significant difference was used to separate the means and graphs were also used to present the points.

**RESULTS AND DISCUSSION**

Presented in this chapter are the results obtained from the current study.

**Proximate Analysis**

***Difference in moisture content between landraces of yam***

This section covers the result of the analysis of variance – ANOVA for percent moisture content of the various yam landraces used for study during the course of this study. There was a significant difference between the yam samples. The yam landrace Yangwode had the highest percent moisture content of 41.84%. This was followed that of Kpako landrace with 41.3%. Table 1, is showing the difference between the percent moisture content of the landraces. Next to these top percent moisture content containing landraces were Giwa, Didiyan and Kwase. The least was Amy being the last followed by Pepa that was second to the last.

***Difference in Crude Protein Content Between Landraces of Yam***

The result of the crude protein content of the landraces is shown in Figure 2 below. Significant differences were found in the crude protein content between the seven specimens where the Kwase landrace had the highest protein content compared to the other six samples ( Table 1 below). It had a value of 14%. This was followed by Pepa, Didiyan, Giwa and Yangwode with values of 10.53%; 10.4%; 10.37% and 10.1% respectively. Kpako landrace had 8.67% crude protein content, but Amy yam landrace had the lest percent crude protein content (of 6.07%).

***Difference in lipid content between landraces of yam***

Result of analysis of variance – ANOVA for the difference in the lipid content (in percentage values) of the yam landrace (Table1 above). Result shows also that there is a significant difference between the samples in their amount of lipid status in which Amy landraces is having the highest content of lipids than other landraces (Figure 3 below). While the percentage value of Amy is 3.43% and the least is the Giwa landraces with 1.53% of lipid content as shown in (Table 1 above) and (Fig 3 below).

***Difference in ash content between landraces of yam***

The analysis of variance – ANOVA shows that there is no significant difference between the landraces. Kpako have the highest content of ashes with the Kwase being the least while Kpako have percentage ashes value of 2.30% and 0.50% for Kwase as shown in (Table 1 above) and (Figure 4 below).

***Difference in pH between landraces of yam***

The result of the analysis of variance – ANOVA shows that there is a significant difference between the landraces in which Kwase have the highest pH with Pepa being the least content while the percentage pH of the Kwase and Pepa is 8.47% and 7.45% respectively as shown in (Table 1 above) and (Figure 5 below).

***Differences in Soluble Solid Content (SSC) between landraces of yam***

The result shows that there is a significant difference between the landraces in the SSC in which Kpako have the highest content and Yangwode with the least value as shown in (Table 2 above) and (Figure 6 below)

***Difference in Starch content between landraces of yam***

The analysis of variance – ANOVA shows that there is a significant difference between the landraces used in the experiment, in their starch content in which Yangwode having the highest content of starch and Didiyan with the least content and the percentage starch content value are 30.15% and 17.58% respectively as showed in (Table 2 above) and (Figure 7 below)

***Difference in total Titratable acidity (TTA) between landraces of yam***

The analysis of variance – ANOVA shows that there is no significant difference between the landraces in time of its total titreable acidity in which Pepa have the highest and Kpako with the least titreable acidity and the percentage titreable acidity are 0.43% and 0.21% respectively as shown in (Table 2.0 above) and (Figure 8 below)

***Difference in water activity between landraces of yam***

The result of analysis of variance – ANOVA shows that there is no significant difference, the Yangwode having the highest amount of water content and Didiyan with the least water content and the values are 1.79% and 1.69% respectively as shown in (Table 2 and Figure 9).

***Differences in Salinity between landraces of yam***

The result of salinity showed that there is a significant difference between the landraces in which Giwa and Amy have the same salinity content value of 1.09, with Didiyan, Pepa and Kpako also having the same salinity status value of 1.06, while Yangwode and Kwase with 1.01 of salinity status as shown in (Table 2 and Figure 10).

**DISCUSSION**

The study shows that the yam were significantly different from the result of Proximate Analysis, in terms of the Protein content, Moisture content, Lipid content, Ashes content, pH, Starch content, Soluble solid content, Total Titratable acidity, Water activity, and Salinity. It was recorded that in the result of the average mean of Protein content that Kwase had an average of 14%, Amy had an average of 6.07%, yangwode had an average of 10.10%, Pepa had an average of 10.53%, Giwa had an average of 10.37%, Didiyan also had an average of 10.40%, and Kpako 8.67% which means that landrace Kwase had the highest amount of Protein content.

In terms of Moisture content, Kwase, Amy, Yangwode, Pepa, Giwa, Didiyan, and Kpako all had the average mean of 35.71%, 33.98%, 41.84%, 34.73%, 40.88%, 38.63%, and 41.23%, respectively with “Yangwode” the highest amount of Moisture content. The analysis further shows that Kwase, Amy, and Kpako got the best Protein content, Lipid content, and Ashes while Yangwode has the best in Moisture content and Starch content respectively. Hence, they are also the best in terms of Nutritional and Starch values compared to the rest landraces. Sensory evaluation of differences in Starch content of yam landraces shows that there were significant differences in the Colour of the landraces.

**CONCLUSION**

The difference in Starch content of yam landraces is very important because it will help farmers to cultivate the best yam landraces and to boost their production of the best marketable landraces. Therefore “Kwase” is the best in terms of the Nutritional qualities of yam tuber, and sensory evaluation, quality shows that “Amy” and “kwase” are the best in Colour.

**RECOMMENDATION**

Based on the findings of this research work, particularly on the differences in starch content among the seven yams (*Dioscorea spp*) landraces, I recommend that:

1. Kwase can be recommended to farmers of the state for their cultivation because of its high protein content and the good quality of the tubers at production of the yams.
2. Yangode and Kwako landraces can be recommended based on their possession of high starch content.
3. It is possible to suggest that additional work should be done to find out if starch from yam can be used in places like the textile industry.

**Table 1.** Result of proximate analysis of the different yam landraces studied in the course of the study.

| Yam Landrace | % MC | % Protein | % Lipid | % Ashes | pH |
|---|---|---|---|---|---|
| Kwase | 35.7 | 14.0 | 2.1 | 0.5 | 8.5 |
| Amy | 33.9 | 6.1 | 3.4 | 0.9 | 7.9 |
| Yangwode | 41.8 | 10.1 | 3.3 | 0.5 | 8.4 |
| Pepa | 34.7 | 10.5 | 3,0 | 1.3 | 7.5 |
| Giwa | 40.9 | 10.4 | 1.5 | 1.9 | 8.4 |
| Didiyan | 38.6 | 10.4 | 3.2 | 1.9 | 8.2 |
| Kpako | 41.3 | 8.7 | 1.6 | 2.3 | 8.1 |
| SE± | 0.5 | 0.5 | 0.18 | 0.09 | 0.10 |
| LSD (0.05) | 0.71 | 0.71 | 0.51 | NS | 0.28 |

NS=no significant difference

**Table 2.** Result of proximate analysis of the different yam landraces studied in the course of the study.

| Yam Landraces | % SSC | % Starch | % TTA | g/cm3 Water activity | % Salinity |
|---|---|---|---|---|---|
| Kwase | 0.32 | 22.64 | 0.41 | 1.78 | 1.01 |
| Amy | 0.51 | 17.64 | 0.42 | 1.74 | 1.09 |
| Yangwode | 0.10 | 30.15 | 0.31 | 1.79 | 1.01 |
| Pepa | 0.50 | 22.91 | 0.43 | 1.73 | 1.06 |
| Giwa | 0.12 | 18.95 | 0.40 | 1.75 | 1.09 |
| Didiyan | 0.16 | 17.58 | 0.40 | 1.69 | 1.06 |
| Kpako | 0.52 | 28.51 | 0.21 | 1.76 | 1.06 |
| SE± | 0.03 | 0.16 | 0.03 | 0.03 | 0.03 |
| LSD (0.05) | 0.08 | 0.45 | NS | NS | 0.06 |

NS=no significant difference

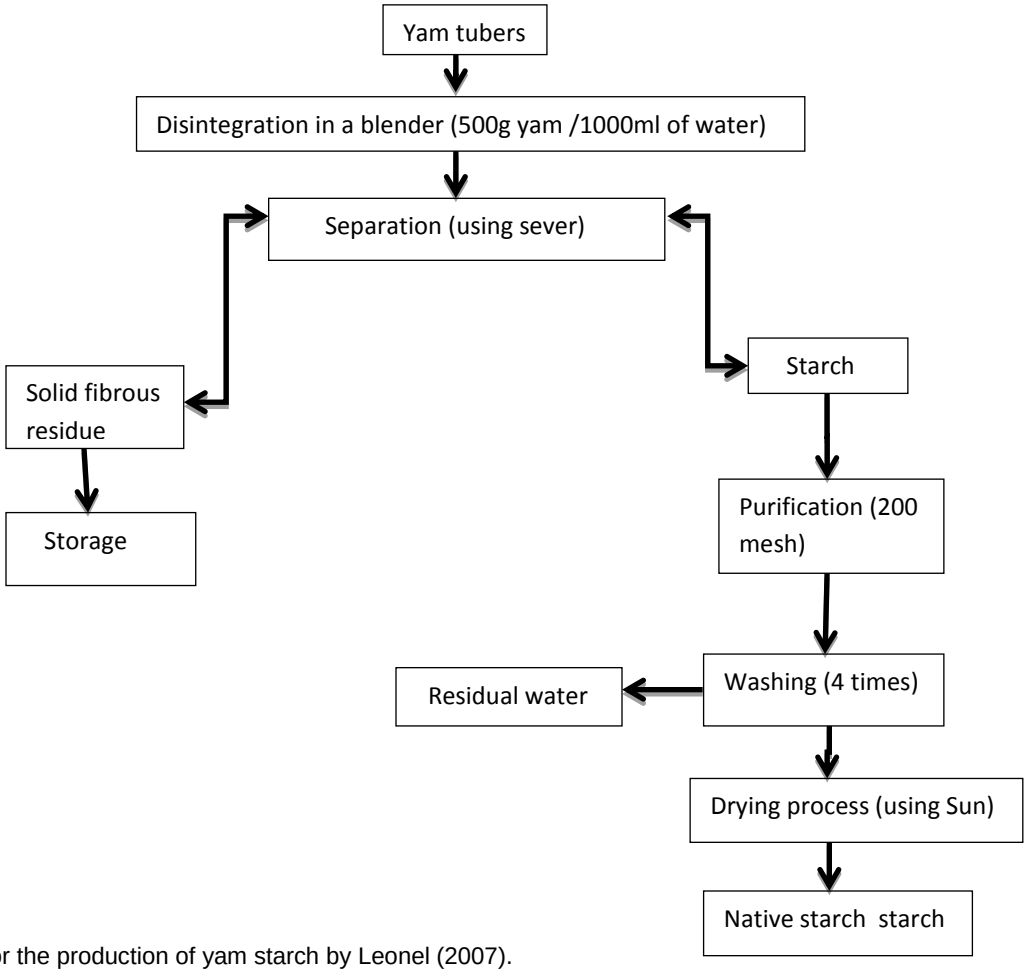


**Fig. 1**.Flowchart for the production of yam starch by Leonel (2007).

**THE PICTURE OF YAM LANDRACES**


**Plate.1. KWASE LANDRACES**


**Plate.2. AMY LANDRACES**


**Plate.3. YANGWODE LANDRACES**


**Plate.4. PEPA LANDRACES**


**Plate.5.GIWA LANDRACES**


**Plate.6.DIDIYAN LANDRACES**


**Plate.7.KPAKO LANDRACES**

**THE PICTURE OF STARCH**

**Plate.8. KWASE**

**Plate.9. AMY**

**Plate.10. YANGWODE**

**Plate.11. PEPA**

**Plate.12. GIWA**

**Plate.13. DIDIYAN**

**Plate.14. KPAKO**

## REFRENCES


**Amani N.G (2002).** Propriétés physico-chimiques et moléculaires des amidons d'igname (Dioscorea spp.) cultivées en Côte d'Ivoire. Relation avec la stabilité des gels aux traitements technologiques. Thèse de doctorat d'état ès science. Université d'abobo-adjamé. p. 203.

**AOAC. (2000).** Official Methods of analysis 15th edn.Assoc. Official Anal.Chem. Washington, D.C, U.S.A.

**Food and Agriculture Organisation (FAO). (2004).** Online Statistical Database. Rome, Italy: Food and Agriculture Organization of the United Nations.

**Freitas,** C., lydersen, C.,lms, R.A., Fedak, M.A. and kovacs, K.M. (2008) A simple new algorithm to filter marine mammal Argos locations, Mammal Science 24: 315-325.

**Girardin**, S. E. *et al,* (2003a) Nodu detects a unique muropetide from Gram negative bacterial peptidoglycan. Science, 300, 1584-1587.

**Otoo, E.** and E.Asiedu, (2009). Sensory evaluation: The last hurdle in varietal development of yams (*Dioscorea rotundata*, Poir) in Ghana. Afr. J. Biotechnol.,8:5747-5754.