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Evaluation of the Effect of Storage Methods on the Functional Properties of Yam Flour

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Abstract

This study investigated the effect of storage methods on some of the functional properties of yam flour obtained from two varieties of yam stored in two different methods. The two yam varieties used were: ***Dioscorea rotundata*** *and* ***Dioscorea alata*** *(that is white yam and water yam) with a view of providing information that will enhance their end use. The yam varieties were stored in the barn and in the house for 4-12 weeks, weighed, chipped/peeled under running water, dried under the sun, milled into yam flour. The yam flour samples of each month of storage of the two different storage methods were analyzed for the swelling capacity (sc) gelatinization point (Temperature) (GP/T), fat absorption capacity (FAC), water absorption capacity (WAC) and bulk density (BD) the results of this study shows that the tuber weight decreased with time of storage. Generally the white yam of both storage method had more weight loss than the water yam. Also weight loss were more in the barn than in the house storage. The water absorption capacity of the yam varieties did not differ under barn but differed at in house storage. The swelling capacity were somehow. The difference of both storage conditions bulk density showed significant difference. The fat absorption capacity did not show much difference. The swelling capacity was observed not to be influenced / affected by the two storage conditions, lastly, signs of deterioration was noticed in some of the tubers under the two storage methods. The result of this study shows that the yam stored in house were better than those stored in the barn. Therefore any yam intend for further* *processing should be stored in the warehouse since their sample flours proved it. These will enhance and extend shelf life and avail yam and its product at all seasons.*

Key words: *Storage, yam, Barn, Farm, Flour and in house*

Introduction

The yams are the most important food crop in west Africa except for cereal (Onwueme, 1978).

Yams are the most important staple food of the west Africans, Caribbeans, part of south east, Asians, and pacifics, though their relative importance varies with region, Country, culture (CTTA, 1995) Yams are second to cassava as a carbonhydrate sources in terms of consumption and economic value (Onayemi, 1974)

Yams of the genus Discorea (family discoreace) form a very important and staples in the tropic. However, Discorea rotandata is the most important and valued yam in the world (Brennan and Ayenor 1973, Onayemi and Potter, 1974)

The carbohydrate, protein, Amino acid, vitamins and mineral contents makes up the food value of the yam.

Due to the importance of the yam tuber, there has been continuous studies / researches in the recent days to produce yam varieties that will be resistance to scorch, foliar disease, nomatodes attacks, yam bettles and other diseases that attack yam tubers either in the field during development or in storage (IITA, 1992) The water yam hybrid (Cultivar) TDA 297 is one of such cultivars that gives high yield resistance to nematodes and have good cooking and physical structure. Though their tuber shape is not as good as the best local varieties***D. alata*** (IITA, 1992).

Food processing and preservation involves any operation that will improve/ add value and extend the shelf life of food products during harvest, and storage, thereby limiting the level of post-harvest losses.these may start from simple washing and cleaning of the food materials to the more complicated processes of food preservation. These includes all the treatments given to food materials from the farm to the point of consumption (Awan and Okaka,1983) during food preservation and processing, some chemical reaction do occurs between the components of the food materials which leads to the

destruction of micro-organism and interaction of enzymes. Food preservation or processing is aimed at improving value (quality) prolonging shelf-life and sanitary condition and also creating varieties. Processing yam tuber into flour enhance its shelf-life and as well minimize the labour and time needed for processing yam tuber into yam fufu and other various yam products. Yam tuber is used by different people in diverse form. It may be fried, roasted, production of fufu, (pounded yam), boiled and eaten with sauce, red oil, stew, pepper and vegetables and soup of different kinds. It is equally used as thickener of soup production of jellies and yam candis, processed into flour for baking bread, yam composite flour and yam flakes (Degras, 1993)
Drying, one of the processing methods affects the final property of the yam flour (Norman, 1967), the processes followed to obtain yam flour would influence their physical/chemical properties of the end product. (Kemanan et al (1987) which may be accepted or unaccepted. The effect of processing operations on some of the functional properties under investigation on yam flour will be carried out next.

Materials and methods

Two yam varieties “ji ocha” (***Dioscorea rotundata***) and “*abana*” (***Alata***) were obtained from Okwo Ngbo Market. The yam tubers were in good state, without physical damages and free from rot. They were stored in two different places and environment: (The barn and in house environments). The following equipment /facilities were used on the cause of the study: Barn: Made of ogirisi, wood angle nets , cage, sticks, laboratory room, warehouse/store, harved/trip weighing balance, metller balance, model P1210, centrige, IIEE centra 3c, thermometer, also used are retort stand, centrifuge tubes (15ml) stainless pot, knife, beakers conical flask (100 ml), (10 ml measuring cylinder, tube ranks, saptular, rubber stirrer rod, foil paper, stove and milling machine (attrition mill) or blender.,
During storage these parameter were checked from the yam samples, rot, pest attack sprout, weight loss, and other deteriorative effects at periodical intervals. The harvad trip balance used for weighing, sprout removed, sense organ for checking out word diffects such like sprouting pestattack, rot and other deteriorative measure. Record are taken if. Any processing of yam tuber to flour, the tuber under storage were taken and peeled using stainless knife. It was peeled under water and thereafter sliced using the same knife to about 1cm

thick. The sliced yams were then sprayed on clean tray pans and foil and dried under sun until moisture content of 10% was achieved.

The dried samples were then milled to flour in/with a blending machine. The milling machine was clean very well, some samples milled during cleaning to ensure that there is no contamination in the sample for the analysis. After the milling, the yam flour samples were used for the analysis. This was repeated/done for the first, second and third month.

Flow chat for the preparation of yam flour

Yam tuber
↓
peeling
↓
Washing
↓
Cutting (under water)
↓
Sticing (2 -2.5mm
↓
Sun drying
↓
Dry milling
↓
Yam flour
↓
Packaged yam flour

Sample analysis

Bulk density – The method of Okaka and potter, 1979 was adopted. Bulk Density of the flour sample was determined by weighing out 30g of sample into

100ml measuring cylinder and tapped ten (10) times against the palm; the volume of the flour after tapping was recorded and bulk density was expressed as kgm-3

Bulk density (BD)

$$BD = \frac{\text{weight of sample}}{\text{Volume of samples (tapping ten times)}}$$

Swelling capacity (SWC)

The method described by Ukpabi and Ndumele (1990) was adopted weigh out 10g of sample, transfer into 100ml measuring cylinder, record the dry volume, add 60ml of distilled water, allow to stand for (4)four hours; then record the swelling volume. Calculation is by the use of this expression

$$SWC = \frac{\text{swelling – dry volume X 100}}{\text{Dry sample}}$$

Fat absorption capacity (FAC)

The method of Lin and Humbert (1974) was adopted.

10g of sample flour was weighed out into a 15ml centrifuge tube. 5ml of vegetable oil (solive) was measured and poured into the centrifuge, the mixture-stirred properly until homogenous/uniform mixture was obtained, it was allowed to stand for 30 minutes. The sample was centrifuged at a speed of 3000.rpm for 15minutes. The volume of the supernatant taken and the fat absorption capacity calculated using the formula:

$$FAC = \frac{\text{Original volume of oil – Vol after centrifuge}}{\text{WT of samples}}$$

Water absorption capacity (WAC)

The method of Okaka etal was used. 1g of sample was weighed out and placed in a centrifuge tube (15ml) 10ml of water (distilled) was added, the mixture homogenized. The sample centrifuged at 200.rpm for 15minutes. After centrifuging, the clear liquor was decanted into a graduated cylinder and the volume determined.

The water absorption capacity was calculated using this expression:

$$WAC = \frac{10ml - \text{Vol of liquor decanted}}{\text{Weight of sample}}$$

$$\% \; WAC = \text{ml of water absorbed} \times {}^{100}/_{1}$$

Gelatinization temperature (GT)

The method of Narayana and Narasanya a-Rog (1982) was used to determine the gelling temperature of the samples. 25g of the sample flour was measured out and dissolved in 100ml of distilled water in a beaker, and stirred thoroughly. A thermometer was clamped on to a retort stand with its bulk submerged in the beaker. The beaker placed in a boiling water and continuously stirred as heating continued. This continued until the sample gelled and the temperature at which it gelled taken as the gelatinization temperature.

Sensory Evaluation

The eating quality of the yam varieties was determined by reconstituting the yam flour into fufu and subjected the reconstituted sample to sensory evaluation. 10g of flour from each sample was poured into 30ml of boiling water and mixture was continuously stired until jelled dough, then obtained and presented to a panel of 5 judges drawn from students.

The judges used a point hedonic scale to rank the sample according to their preference they evaluated the colour, texture, stickiness and overall preference using 1 to represent the best and 0 to represent the most inferior sample.

Result and Discussion

Result of functional properties analysis of first month storage

Discr	**BD.**	**G.T**	**WAC%**	**FAC%**	**SC%**
N_1W	67.5	75^{OC}	140	110	74.4
N_1B	73	75^{O}	120	120	58.8
O_1W	68.0	76^{OC}	160	120	76.5
O_1B	75	78^{OC}	160	120	71.2
Second month of storage / analysis					
N^2W(%)	BD(%)	G.T	WAC(%)	FAC(%)	SC(%)
	67.0	80^{OC}	150	100	71.4
N_2B	61.0	80^{OC}	140	100	54.3
0_2W	65.0	82^{OC}	160	100	83.3

O_2B	64.5	82^{OC}	180	100	73.5
Third month of storage/Analysis					
N_3W	60.0	82^{OC}	150	120	71.4
N_3B	65.5	82^{O}	140	100	60
O_3N	68.5	80^{OC}	160	80	55.0
O_3B	67.0	80^{OC}	160	80	52.0

Bulk density: from the result of analysis carried out, it was discovered that there is a significant difference among the samples analyzed, meaning that the methods of storage affects the BD of the yam flour. As the storage continues the sample used for the analysis decreased in its bulk density and then increased, though this was seen in the samples stored in the barn, but not much. The samples stored indoors maintained uniform decrease in bulk density value.

Therefore, the cohesion and adhesion properties of stored yam flour varieties are not significant in water yam (D ***alata***) but somehow observed in white yam flour (D **rotundata**). Indoor stored samples preferred for long storage of yam for purpose of different usages preservation and processing into various other forms.

Gelatinization temperature: In the result analysis for gelatinization temperature, it was discovered that the gelatinization temperature was however known to increase with processing temperature as a result of cell rupture during the process of drying the samples (Asiedu, 1989). It is equally believed that the gelatinization temperature of yam varieties is seriously affected by the method used in drying the sample for the yam flour. Storage affects this parameter in much ways. From the result of the analysis on the samples stored for 1,2, and 3 months, it was observed that their gelatinization temperature increased in both varieties.

There were differences between samples of first, second and third months but second and third months does not show much differences from the results obtained. The first month sample ranged from 75^{O} - 76^{O} for indoor storage and 75^{O} - 78^{O} for open barn storage, second months samples is 80^{Oc} - 82^{Oc} for both indoor and open barn storage and third month storage ranged from 82^{O} - 80^{O} for both open barn and indoor storages of all the yam varieties samples. Therefore, storage method affects the gelatinization temperature of yam varieties. Yam flour sample stored indoors (NW, Ow) ie at room temperature has high gelatinization temperature than those sample stored in the barn.

Water absorption capacity (WAC) – This parameter is the ability of the yam flour to absorbed water. This tells how yam flour absorbs water. The water absorption of the yam flour from two varieties of yam stored under barn and indoor(W) for one, two and three months were analyzed. The WAC of yam samples stored indoor for both white and water yam ranges from 14% - 160% and barn rages from 120% - 160% one month then, two months 140% - 180% for both methods and varieties and three months was 150% - 160% for indoor and 140% - 180%.

The analysis carried out shows that storage time, varieties under indoor storage, significantly affected the water absorption capacity of stored yam flour/tuber. The two yam varieties under different storage method differed in their water absorption capacity. Water yam has higher water absorption capacity than the white yam. This higher WAC was in the yam flour sample stored under indoors (in house) storage. Barn stored sample analysis showed that there is a significant different on the storage time, method and the interaction in the WAC of stored yam tuber.

The two yam varieties did not differ at their WAC under barn storage. The difference seen at the indoor storage could be due to high metabolic activities of the yam sample which lead to high WAC of their flours.

Swelling capacity

The table seen above contains the result of the swelling capacity of yam flours of two yam varieties stored under two different storage methods (Barn and Indoor) for period of one, two and three months. The swelling capacity of yam stored indoor for one month ranges from 74.2-76.5, and 58.8 – 71.2 for two months indoors 71.4 – 83.3 and 54.3 – 73.5 and the three months indoor 55.0 - 71.4 and 52.0 – 60.0 from the result of the analysis, It was observed that storage time, methods and varieties sample affected the swelling capacity under indoor (in house) storage while barn sample analysis equally proves that there is a significant difference on the time, varieties and interaction of stored yam tubers. These means that the swelling capacity for yam tuber does not depend on storage for short period but for long period storage, the swelling capacity depend on storage time and methods (conditions). The yam will continue to swelling as storage progressed especially indoors method due to the presence of starch granules present in the stored yam tubers. Short time storage both barn and in house may not affect the yam (flour) starch granule but from the result it may be affecting the starch granule which brings about swelling under long time storage.

Fats Absorption Capacity (FAC)

Fat Absorption capacity is a functional properties that shows how yam flour or tuber absorbs oil, fat when cooked whole or processed into flour or other forms. From the result of the analysis, stored yam absorb less quantity of oil or fat. On this note, there was no significant differences observed in the test for FAC of the sample. The analysis equally shown that the sample of the one month storage was more than two months and three months; freshly harvested yam absorbs more than stored yam samples. The physical entrapment of oil which is brought about by protein content in the flour (Kinsela, 1970), knowing also that the protein value of yam varieties are almost the same, the FAC may not differ reasonably, this could some how explain this result.

Conclusion

Yam tubers stored under these two storage methods – barn and indoors (In house) will respond/experience some change both physical and chemical wise eg: weight loss, outward defects, colours changes etc. however, the swelling capacity, water absorption capacity and other functional properties were not influenced or affected by storage methods except fat absorbing capacity. The storage condition barn or indoor did not adversely affect the functional properties and other composition like nutrients within short period of storage but can affect when the yam tuber stored up to 4 or 5 months and above.

Though barn storage is a conventional method for tubers storage for long time but for short time storage, yam can be stored in house without much adverse effect on the yam tuber.

Therefore, from this study, I observed and concluded that yam tubers meant to be preserved or processed into various form of yam product can be stored in both storage methods, since it's all functional properties are retained except fat absorbing capacity which both methods of storage affected but not much adversely. So, in-house storage is much preferred to barn storage because of physical deterioration seen on the skin of the yam tubers and much moisture due to night dews which triggers rotten (outward) which may penetrates into the edible portion and also encourage microbial deterioration and spoilage as a result of internal chemical reaction. This which leads to post harvest losses.

Meanwhile to cub this, in house (indoors) storage is advised and haste be done to process yam tuber into other more convenient form of the yam product, for proper/ long time storage and preservation.

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