International Journal of Research in Agricultural Sciences
Volume 3, Issue 5, ISSN (Online): 2348 – 3997

Effects of Storage Conditions and Time on the Physicochemical Properties of *Dioscorea Rotundata* (*ASOBAYERE*)

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Abstract **– Yam is a tuber crop which belongs to the family Dioscorea spp. It is a semi perishable class of food diet due to its high moisture content. The effect of three storage facilities (cold room, yam bit and yam barns) and time of storage were determined on stored yam samples (*Asobayere*) over a 5 month study period. The physicochemical properties of the yam samples were carried out one month after storage for 5 consecutive months to assess the quality of the *Asobayere* in terms of its physicochemical properties. The study shows that storage facilities and storage time affect the quality of stored *Asobayere*. Yam pit retained the most moisture of 63.05% and yam barn recorded the highest carbohydrate of 38.43% at the end of the third month of storage. The cold room which maintained the most quality recorded high value for fibre (1.14%) and protein (5.58%). There was a general drop in water binding capacity for all the three storage facilities after the second months of storage and a drop in swelling power and solubility after the first month of storage. The quality of yam deteriorated significantly over time but this was also found to be influenced by the type of storage facility.**

Keywords **– Chemical Composition, Functional Properties, Storage Facility, Storage Time of Yam.**

I. Introduction

Yam belongs to the genus Dioscorea (family Dioscoreaceace) and consists of an estimated 300-600 species. Yam varieties cultivated for the Ghanaian market include *Pona, Dabriko, Dente, Nkani, Afasie, Muchumudu, Afum, Apoka, Asobayere, Ediamawoba* [1]. *Asobayere*, one of the most important cultivar of D. rotundata species is enjoyed especially in Ghana and found predominantly in the Ashanti and Brong Ahafo regions of Ghana. Due to its cooking quality, it commands a high price compared to other yam cultivars. *Asobayere* is preferred by many consumers and is gaining some amount of popularity. This is as a result of its unique characteristics such as permeable light skin and the tail region of the tubers which usually resembles human foot with toes.

Yam is a semi-perishable class of food due to its relative high moisture content [2] and is subjected to high losses during transportation and storage and this has affected the quality of the yam product. The quality of yam is known to be primarily determined by the physicochemical properties. For this reason, many authors [3]-[7] have studied and reported on the physicochemical and pasting characteristics of yam.

Stored yam tubers respire at reduced levels in the dormant state usually after harvesting. Consequently, several physiological and biochemical changes are known to occur which may negate or enhance the food quality of tubers [8]-[12]. Traditionally, farmers store yam tubers in small quantities using simple storage techniques. The type of storage structure that they usually employ is influenced by climatic conditions, the purpose of the yam tubers in storage, type of building materials available and the resources of the farms [13].

The principle involves keeping uninjured tubers in barns, usually on a raised platform, or tying the tubers singly to live poles to provide shade and allow good ventilation. Some are also stored in yam pits, barns and warehouses [14]. Free air circulation and a low temperature are essential for good storage. There are also underground and storage housing structures, sheds, huts, silos and cribs [15]. Tubers may also be left underground for several weeks as a storage method.

There is little information available on the various storage methods, storage time and the effects they have on the overall quality of yam, probably leading to the underutilization of these yam varieties. Knowledge on storage time and methods of *Asobayere* would lead to better understanding of appropriate storage condition necessary for longer shelf life. The aim of this work is to study the effects of storage facilities and time on the physicochemical properties of the *Asobayere*.

II. Material and Methods

2.1. Collection and Transport of Yam

Fifty fresh yam tubers without injury, rot or decay were obtained from a popular yam growing community in selected farms at Asante Mampong, Ghana. The yam tubers were wrapped in dry greaseproof paper and packed into cartons and transported to Kwame Nkrumah University of Science and Technology. On arrival, the yam tubers were randomly selected and divided into three group of fifteen each and then stored in three storage facilities. The storage facilities were local yam barn, pit yam barn and cold room for a period of 5 months.

2.2. Preparation of Storage Facilities and Storage of Yam

2.2.1. Storage of Yam Tubers in the Yam Barn

The yam barn used for this study was constructed by Asante Mampong District Food and Agriculture Ministry and awarded to the best farmer in the district. The yam barn was erected in the open air (Fig. 1) and the fifteen tubers of *Asobayere* were arranged in horizontal but not tied above each other.

Fig. 1. Structure of a wooden yam barn

2.2.2. Storage of Yam Tuber in Pit

The underground pit (Fig. 2) was constructed at the Centre for Scientific and Industrial Research (CSIR), Kumasi-Ghana. The pit was square in shape and a depth of about 2 ft. Fifteen tubers of yam were stored in the underground pit on a layer of straw with the top vertically downward beside each other. The yam tubers were then covered with straw.

Fig. 2. Structure of a yam pit

2.2.3. Storage of Yam Tuber in Cold Room

The cold room at the Centre for Scientific and Industrial Research (CSIR), Kumasi-Ghana, was used for this study. The yam tubers were arranged horizontally against each other on racks in the cold room (Fig. 3). Yam tubers were stored in these storage facilities for 5 months. At the end of each month for 5 consecutive months, three tubers of *Asobayere* were randomly selected from the three storage facilities for flour preparation and analysis.

Fig. 3. Structure of a cold room showing arrangement of yam at storage

2.3. Flour Preparation

The yam tubers were washed, peeled, sliced into cubes and dried in hot air oven at a temperature of 60 °C for 72 h. The dried yam chips were then milled using a hammer mill with a 250 µm sieve to obtain yam flour. The flour was packaged in low density polyethylene zip-lock bags and stored under refrigeration (4 oC) for further analysis.

2.4. Chemical Composition of Yam Flour

The proximate composition of the yam flour sample was determined as prescribed by Association of Official Analytical Chemist [16].

2.5. Functional Properties of Yam Flour

2.5.1. Determination of Water Binding Capacity

Water binding capacity of yam flour was determined according to the method of [17]. An aqueous suspension of yam flour was made by dissolving 2 g (dry weight) of flour in 40 mL of distilled water using a weighed 50 mL graduated centrifuge tube. The suspension was agitated for 1 h on a Griffin flask shaker and centrifuged at 2200 rpm for 10 min. The free water (supernatant) was decanted from the wet flour, drained for 10 min and the wet flour was then weighed. The water binding capacity was calculated by difference as follows:

Water binding capacity (%) =

$$\frac{weight\ of\ bound\ water \times 100}{weight\ of\ sample}$$

2.5.2 Determination of Solubility and Swelling Power

Solubility and Swelling power determinations were carried out based on a modification of the method of [18]. One gram of yam flour was dissolved with distilled water to a total volume of 40 mL using a weighed 50 mL graduated centrifuge tube. The suspension was stirred just sufficiently and uniformly avoiding excessive speed. The slurry in the tube was heated at 85 OC in a thermostatically regulated temperature water bath for 30 min with constant gentle stirring. The tube was then removed, wiped dry on the outside and cooled to room temperature. It was then centrifuged at 2200 rpm for 15 min. The supernatant was decanted into a pre-weighed moisture can. The solubility was determined by evaporating the supernatant in a thermostatically controlled drying oven at 105 OC and weighing the residue. The sediment paste was weighed and swelling power was calculated as the weight of sediment paste per gram of flour used.

$$\text{Swelling power} = \frac{weight\ of\ sediment}{sample\ weight - weight\ soluble}$$

$$\%\ \text{Solubility} = \frac{weight\ of\ soluble \times 100}{weight\ of\ sample}$$

2.6 *Statistical Analysis*

Data obtained for the proximate and functional properties were subjected to ANOVA and tested the effect of storage facilities and storage time on the stored yam at P<0.05. Stat graphic centurion xv was for this purpose.

III. RESULTS AND DISCUSSION

3.1. Proximate Composition of Yam Sample

Influence *by Storage Facility and Time*

There was a general decrease in moisture content for all the storage facilities used as the storage time increases especially the first month after storage with fluctuations in the proceeding storage time. The moisture content of yam prior to storage in the cold room was 62.62 % but decreased to 55.89 % after one month of storage (Table 1). At the second month of storage, a significant increased in moisture content (59.42 %) was observed but decreased in the third and fourth month (57.12 and 56.91 % respectively) of storage and rise again to 58.25 % in the fifth month. The observed decrease and increase in moisture content of *D. rotundata* in cold room as storage time increases was all lower than the value 64.40 % as reported by [19].

A similar trend of moisture content variations was observe when the yam was stored in yam barn but increased in the fifth month. The only increased in moisture content after the first month of storage was observed when the yam was stored in pit and again recorded a moisture content of 60.74 % in the fifth month of storage which was higher than that observed for cold room and yam barn (58.25 and 54.71 % respectively). The reason for higher moisture content in the fifth month may be due to the pit providing protection to the yam from respiration and transpiration. The observed variation in moisture content in this study was in range (50.0-80.0 %) as reported by researchers [19]-[21].

No significant difference was observed for crude fat before storage and at the end of storage when stored in cold rom. Again, none of the storage facilities resulted in increase in fat content at the end of the storage period. Also, no significant difference was observed in the third and fourth month of storage when yam was stored in barn and pit.

The fibre content of the D. rotundata before storage was 0.26 % but this was observed to increase when stored in cold room. No significant change was observed for all the storage period with the exception of the second period which recorded an increase in fibre content of 1.14 % which was higher than fibre values of yam varieties as in unpublished [22].

Unlike the cold room, no significant difference was observed from the first to the fourth month (0.51, 0.52, 0.51 and 0.48 % respectively) of storage when yam was stored in barn but was significantly different at the fifth month (0.60 %) of storage and before storage (0.26 %). Storing yam in pit also showed an increased in fibre content. The highest fibre content of 0.56 % was recorded when the yam was stored for four months but this was not significantly different from the fifth month of storage.

Ash content is a measure of the mineral status of a sample and this was observed to be 1.32 % before storage. Yam stored in cold room maintains the same ash content with the first month of storage but decreased to 1.15 % after the third month of storage. A rise in ash content was observed at the fourth month of storage and this increased to 1.39 % at the end of the fifth month of storage. When yam was stored in barn, a higher ash content of 1.79 % was observed after the first month of storage. However, no significant difference was observed for all the storage period. Yam stored in pit followed a similar trend as compared to yam stored in cold room. Higher ash content of 1.52 % was observed at the end of the storage period (5 months). Values observed in this study for all the storage condition was lower than that reported by [21].

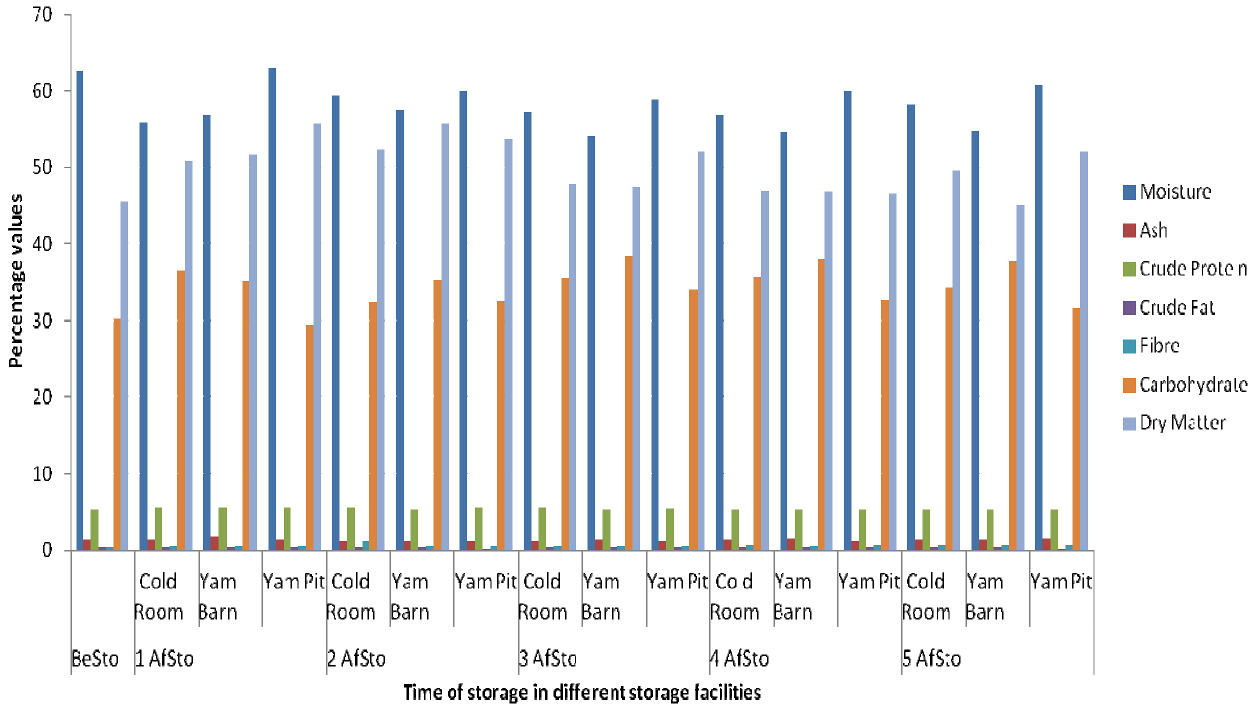
Crude protein content of yam before storage was observed to be 5.32 %. An increased in protein content of 5.58 % was recorded when yam was stored in cold room for the first three months. Protein content dropped when the storage period got to the fourth month (5.32 %) but rise again to 5.33 % without any significant change. Yam stored in barns had a fluctuation in the protein content as the storage period increases. An increase in protein content was observed in the first month of storage, dropped in the second month, increase again in the third month, dropped and increased in the fourth and fifth month respectively. When yam was stored in pit, a higher protein content of 5.58 % was recorded in the first month of storage but decreased to 5.29 % at the end of the storage period (5 months).

Before storage, the carbohydrate content of the yam was showed to be 30.21 % but this increased to 36.42 % when stored in cold room for one month. A significant drop was observed in the second month of storage

Table 1: The mean [1, 2] effects of storage time and different storage facilities on the chemical composition of yam flour

Storage facility	Storage time /month	Moisture	Crude Fat	Fibre	Ash	Crude Protein	Carbohydrate	Dry Matter
Cold room	Before Storage	62.62 ± 2.06^{c}	0.27 ± 0.01^{a}	0.26 ± 0.01^{a}	1.32 ± 0.03^{abc}	5.32 ± 0.02^{a}	30.21 ± 2.02^{a}	45.59 ± 5.10^{a}
	1	55.89 ± 0.25^{a}	0.26 ± 0.05^{a}	0.53 ± 0.02^{a}	1.32 ± 0.01^{abc}	5.58 ± 0.06^{b}	36.42 ± 0.22^{c}	50.78 ± 3.0^{a}
	2	59.42 ± 2.49^{b}	0.27 ± 0.05^{a}	1.14 ± 0.43^{b}	1.16 ± 0.01^{ab}	5.58 ± 0.06^{b}	32.42 ± 2.78^{ab}	52.40 ± 2.83^{a}
	3	57.12 ± 1.77^{ab}	0.26 ± 0.05^{a}	0.52 ± 0.04^{a}	1.15 ± 0.02^{a}	5.58 ± 0.07^{b}	35.38 ± 1.73^{bc}	47.78 ± 2.72^{a}
	4	56.91 ± 1.43^{ab}	0.25 ± 0.05^{a}	0.55 ± 0.01^{a}	1.37 ± 0.20^{bc}	5.32 ± 0.14^{a}	35.60 ± 1.67^{bc}	46.95 ± 5.92^{a}
	5	58.25 ± 1.78^{ab}	0.24 ± 0.04^{a}	0.54 ± 0.02^{a}	1.39 ± 0.23^{c}	5.33 ± 0.08^{a}	34.24 ± 1.68^{bc}	49.58 ± 3.27^{a}
Yam barn	Before Storage	62.62 ± 2.06^{d}	0.27 ± 0.01^{b}	0.26 ± 0.01^{a}	1.32 ± 0.03^{a}	5.32 ± 0.02^{ab}	30.21 ± 2.02^{a}	45.59 ± 5.10^{a}
	1	56.94 ± 0.39^{bc}	0.24 ± 0.03^{ab}	0.51 ± 0.01^{b}	1.79 ± 0.81^{a}	5.51 ± 0.05^{b}	35.01 ± 0.67^{b}	51.64 ± 2.30^{ab}
	2	57.44 ± 1.49^{c}	0.24 ± 0.01^{ab}	0.52 ± 0.01^{b}	1.19 ± 0.03^{a}	5.24 ± 0.22^{a}	35.38 ± 1.45^{b}	55.70 ± 6.22^{b}
	3	54.09 ± 1.36^{a}	0.24 ± 0.01^{a}	0.51 ± 0.07^{b}	1.40 ± 0.04^{a}	5.34 ± 0.08^{ab}	38.43 ± 1.39^{c}	47.43 ± 3.06^{a}
	4	54.51 ± 1.07^{a}	0.24 ± 0.01^{a}	0.48 ± 0.02^{b}	1.42 ± 0.11^{a}	5.26 ± 0.11^{a}	38.09 ± 0.99^{c}	46.86 ± 3.12^{a}
	5	54.71 ± 1.09^{ab}	0.24 ± 0.01^{ab}	0.60 ± 0.07^{c}	1.33 ± 0.12^{a}	5.31 ± 0.15^{ab}	37.80 ± 1.22^{c}	45.08 ± 1.37^{a}
Yam pit	Before Storage	62.62 ± 2.06^{ab}	0.27 ± 0.01^{b}	0.26 ± 0.01^{a}	1.32 ± 0.03^{b}	5.32 ± 0.02^{ab}	30.21 ± 2.02^{ab}	45.59 ± 5.10^{a}
	1	63.05 ± 0.38^{b}	0.27 ± 0.03^{b}	0.50 ± 0.00^{b}	1.32 ± 0.03^{b}	5.58 ± 0.09^{b}	29.28 ± 0.26^{a}	55.70 ± 6.23^{b}
	2	59.95 ± 0.05^{ab}	0.23 ± 0.02^{a}	0.53 ± 0.02^{bc}	1.24 ± 0.11^{ab}	5.57 ± 0.11^{b}	32.48 ± 0.17^{ab}	53.62 ± 5.86^{ab}
	3	58.77 ± 2.18^{a}	0.25 ± 0.01^{ab}	0.51 ± 0.04^{b}	1.15 ± 0.02^{a}	5.40 ± 0.20^{ab}	33.93 ± 2.40^{b}	52.08 ± 5.90^{ab}
	4	60.00 ± 3.19^{ab}	0.25 ± 0.02^{ab}	0.56 ± 0.00^{d}	1.16 ± 0.01^{a}	5.28 ± 0.24^{a}	32.75 ± 3.29^{ab}	46.47 ± 6.59^{ab}
	5	60.74 ± 3.40^{ab}	0.23 ± 0.01^{a}	0.55 ± 0.01^{cd}	1.52 ± 0.05^{c}	5.29 ± 0.13^{a}	31.66 ± 3.45^{ab}	52.06 ± 1.21^{ab}

[1] means of three replicate [2] superscript that do not share a letter in the same column for a particular measurement are significantly different at $P < 0.05$.



Besto= Before Storage, 1 AfSto= 1 month after storage, 2 AfSto= 2 months after storage, 3 AfSto= 3 months after storage, 4 AfSto= 4 months after storage, 5 AfSto= 5 months after storage.

Fig. 4. Effect of storage facilities on chemical composition of *Asobayere*

(32.42 %) but maintains a stable increment in the third and fourth month (35.38 and 35.60 %) and eventually dropped to 34.24 % in the fifth month. Storing the yam in barns had a consistent increase in carbohydrate content from the first month (35.01 %) to the fourth month (38.09 %) of storage.

However, no significant difference was observed between the fourth and the fifth month of storage. A similar trend was observed when yam was stored in pit compared to that of the barn. Yam stored in barns had higher carbohydrate content than those reported by unpublished [22]. The decrease in carbohydrate content observed in different storage facilities could be attributed to the fact that because yam tuber is a living organ, carbohydrates are burned to gain energy during which process CO_2 and H_2O are emitted to the environment as gases.

Dry matter is an important parameter of food quality in root and tuber crops which has an influence on the textural perception of foods [23]. There was a general increase in dry matter in all the storage facilities used. Prior to storage, the dry matter observed was 45.59 % and this increased to 52.40 % in the second month of storage. Yam stored in barns and pit recorded a higher dry matter content of 55.70 %. Although a drop in dry matter content was observed in each storage facilities as the storage time proceeds, it was more than that observed prior to storage.

Climatic conditions (humid and semi-humid tropics) promote continuous methods of production. Despite this, the yam is a seasonal fruit and can only be harvested at certain times throughout the year. For this reason, they have to be stored so that bottlenecks in supply can be avoided. Fig. 4 shows the influence of storage facilities on the chemical composition of yam as storage period increases.

Analysis for the effect of the storage facilities and storage time on the proximate composition showed that, storage facilities affected from moisture, fibre and carbohydrate content significantly over the five month period. The storage time was also found to have a significant effect on the dry matter, crude protein and fibre of the store yam. The effect of both factors on fibre was however found to be influenced by interaction between the storage facilities and storage time.

Losses which can occur during the storage of fresh yams have very varying causes. Some of the losses are endogenous (i.e. physiological) and include transpiration, respiration and germination. Other losses are caused by exogenous factors like insect pests, nematodes, rodents, rot bacteria and fungi on the stored produce.

3.2. Functional Properties of Asobayere Influenced by Storage Facility and Time

Water binding capacity is an important functional characteristic in the development of ready-to-eat foods since high water absorption capacity may assure product cohesiveness [24]. The results indicate that storing yam in cold room had no significant difference over the storage period of 5 months. The water binding capacity of yam before storage was 233.70 % and this increased significantly when stored over the period. A similar trend was observed when yam was stored in barn and pit. It was observed that yam stored in the different storage conditions had improvement in their water binding capacity. The values (Table 2) observed in this study was higher than those reported by unpublished [22]. High water binding capacities observed in this study are desirable as they increase the unit yield of products. It also stabilizes starches against effects such as syneresis, which sometimes occurs during retorting and freezing [25]-[27].

Storing yam before and after one month had no significant change on solubility. However, a decrease in the ability of the yam to dissolve in solution reduced as storage period exceeded one month. No significant change was observed from the second month of storage to the fifth month. Higher solubility value of 11.96 % was detected when the yam was stored in cold room for one month and reduced to 10.14 % at the fifth month of storage.

A different trend in solubility was observed for yam stored in barn and pit. No significant difference was noticed before and after storage for both storage facilities used. However, values observed for yam stored in barn and pit were higher than when stored in cold room with the exception of the first month of storage. The solubility values detected for *Asobayere* in this study are higher than those reported by unpublished [22] for different yam varieties.

The swelling power of *Asobayere* did not show a significant change before (14.54 %) and after (14.92 %) one month of storage. As the storage period proceeds, a drop in swelling power was observed and this was not significantly different but showed significant change when compared with the first month of storage. The trend was the same for yam stored in barn but slightly different those stored in pit. Yam stored in pit had a swelling power of 14.54 % but no significant difference was observed throughout the storage period despite the reduction.

Analysis of the effect of storage structure and storage time on the functional properties of store yam showed some significant effect over the study period. Analysis on the water binding capacity and swelling power with the cold room sample reported the highest average of 280% and 14% respectively over study period. The storage time was also found to have a significant effect on the observed in the fifth month of storage but was also found to indirect or be influenced by the type of storage facilities used.

Table 2. Functional properties of stored *Asobayere* over a 5 months study period

Storage facility	Storage time/month	Water binding	Solubility	Swelling power
Cold room	Before storage	233.70±1.64[a]	11.46±20.56[a]	14.54±7.70[b]
	1	273.57±15.30[b]	11.96± 1.48[a]	14.92± 0.46[b]
	2	287.02±7.16[b]	10.17 ±0.02[b]	13.95 ±3.62a
	3	286.02±7.15[b]	10.15 ±0.03[b]	13.94 ±3.62a
	4	279.01±4.49[b]	10.15 ±0.02[b]	13.92 ±3.61a
	5	278.01±4.49[b]	10.14±0.02[b]	13.55±3.17a
Yam barn	Before storage	233.70±1.64[a]	11.46±20.56[a]	14.54±7.70[b]
	1	249.98± 685[ab]	11.66 ±0.53[a]	14.69± 0.38[b]
	2	268.32±22.70[b]	11.47 ±1.30[a]	10.72± 0.57[a]
	3	267.98±23.00[b]	11.44± 1.25[a]	10.71 ±0.57[a]
	4	258.32±23.30[ab]	11.44 ±1.19[a]	10.70 ±0.57[a]
	5	257.98±21.40[ab]	11.36 ±1.15[a]	10.69± 0.57[a]
Yam pit	Before storage	233.70±1.64[a]	11.46±20.56[a]	14.54±7.70[b]
	1	258.59 ±13.40[ab]	11.80±0.64[a]	13.31±0.87[a]
	2	269.83 ±20.26[b]	11.25±0.53[a]	13.19 ±0.97[a]
	3	269.83 ±20.26[b]	11.25±0.53[a]	13.15 ±0.97[a]
	4	262.83±20.26[b]	11.25±0.53[a]	13.07 ±0.97[a]
	5	261.08 ±23.48[ab]	11.07±0.50[a]	12.70±0.41[a]

Values are reported as means ± SD. Superscripts that do not share the same letter for a particular measurement in the same column are significantly different at P<0.05.

IV. Conclusion

The study showed that both the type of storage facilities and the storage time affected the quality of stored *Asobayere* significantly. The storage facilities was found to have a significant effect on moisture, fibre, carbohydrate, water binding capacity and swelling power. The storage time also affected the quality of stored *Asobayere* yam by significantly influencing dry mater, crude protein and fibre.

Acknowledgment

The authors wish to thank the technical staff of the Biochemistry laboratory at the Centre for Scientific and Industrial Research (CSIR) for their assistance during the practical phase of the study and the use of their cold room. Other thanks go to Asante Mampong District Food and Agriculture Ministry. The authors also wish to thank Ibok Oduro, Nana Baah Pepra-Ameyaw, Eric and Dery for their suggestions.

References

[1] E. Otoo, R. Akromah, M. Kolesnikova-Allen, & R. Asiedu,.(2009). Delineation of Pona complex of yam in Ghana using SSR markers. *International Journal of Genetics and Molecular Biology*, 1(1): 6-16.

[2] K. O. Jimoh, & O. P. Olatidoye. (2009). Evaluation of physicochemical and rheological characteristics of soyabeans fortified with yam flour. *Journal of Applied Bioscience*, 13:703-706.

[3] C. K. Riley, A. O. Wheatley, & H. N. Asemota. (2006). Isolation and charactetrisation of starches from eight *Dioscorea alata* cultivars grown in Jamaica. *African Journal of Biotechnology*, 5(17): 1528-1536.

[4] D. A. Sahorè, N. G. Amani, & G. J. Nemlin. (2005). The properties of starches from some Ivory Coast wild yam (*Dioscorea*) species. *Tropical Science,* 45(3):122- 125.

[5] E.O. Afoakwa, & S. Sefa-Dedeh, (2002). Viscoelastic properties and changes in pasting characteristics of trifoliate yam (*Dioscorea dumetorum*) starch after harvest. *Food Chemistry,* 77: 85-91.

[6] S. N. Moorthy. (2001). Physicochemical and functional properties of tropical tuber starches. *Starch/Starke*, 54:559-592.

[7] V. Rasper, & D. G. Coursey. (1967). Properties of starches of some West African yams. *Journal of Food Science and Agriculture*, 18: 240-244.

[8] A. T. Tschannen, O. Girardin, C. Nindjin, D. Dao, Z. Farah, P. Stamp, & F. Escher. (2003). Improving the application of gibberellic acid to prolong dormancy of yam tubers (*Dioscorea* spp). *Journal of Science, Food and Agriculture,* 83: 787-796.

[9] O. Girardin, C. Nindjin, Z. Farah, F. Eshcher, P. Stamp, & D. Otokore, (1998). Effect of storage on system and sprout removal on post-harvest yam (*Dioscorea* spp.) fresh weight losses. *Journal of Agricultural Science,* 130:329-336.

[10] S. Treche, & T. Agbor-Egbe, (1996). Biochemical Changes occurring during growth and storage of two yam species. *International Journal of Food Science and Nutrition,* 47(2): 93-102.

[11] O. Onayemi, & A. Idowu. (1988). Physical and chemical changes in traditionally stored yam tubers (*Dioscorea rotundata* Poir and *Dioscorea cayenensis* Lam). *Journal of Agriculture and Food Chemistry,* 36:588-591.

[12] O. Mozie, (1988). Effect of storage temperature on storage weight losses in white yam (*Dioscorea rotundata* Poir.) tubers. *Tropical Science,* 28:273-275.

[13] FAO, Food and Agriculture Organisation. Action programme for the prevention of food losses, improving post-harvest handling, storage and processing of root and tuber crops, Rome, Italy, 1990.

[14] B. A. Alabadan, (2002). Assessment of storage losses in roots and tubers in Niger State, Nigeria. *African Journal of Root, Tuber and Crops,* 5(1): 49-52.

[15] V. Ravi, J. Ked, & C. Balagopalan. (1996). Review on Tropical Root and Tuber. In: Critical Reviews. *Food Science and Nutrition,* 36(7): 360-730.

[16] AOAC, Official Methods of Analysis of the Association of Official Analytical Chemist. 18th edn., Horwitz William Publication, Washington, DC., USA, 2005.

[17] D. G. Medcalf, & K. A. Gilles. (1965). Wheat Starches. Comparison of physicochemical properties *Cereal Chemistry*, 42: 538-568.

[18] H. W. Leach, L. D. Mccoven, & T. J. Scoch. (1959). Structure of the starch granule. Swelling and solubility patterns of various starches. *Cereal Chemistry*, 36: 534-544.

[19] F. D. Baah, B. Maziya-Dixon, R. Asiedu, I. Oduro, & W. O. Ellis, (2009). Nutritional and biochemical composition of *D. alata* (*Dioscorea* spp.) tubers. *Journal of Food, Agriculture and Environment,* 7 (2): 373-378.

[20] I. J. Alinnor, & C. O. Akalezi, (2010). Proximate and mineral compositions of *Dioscorea rotundata* (white yam) and *Colocasia esculenta* (white cocoyam). *Pakistan Journal of Nutrition*, 9 (10): 998-1001.

[21] B. O. Otegbayo, A. U. Achidi, R. Asiedu, & M. Bokanga, Food quality attributes of Pona yam. Paper presented at 8th Triennial Symposium of the International Society for Root and Tuber Crops-Africa Branch (ISTRC-AB) held at International Institute of Tropical Agriculture (IITA), Ibadan, 12-16 November, 2001.

[22] R. N. A. Addy, Comparative study on the properties of yam (*Dioscorea rotundata*) varieties in Ghana: A case study in Asante Mampong. A thesis submitted to the Department of Food Science and Technology, Kwame Nkrumah University of Science and Technology, 2012.

[23] T. Izutsu & K. Wani. (1985). Food texture and taste: a review. *Journal of Texture Studies,* 16(1): 1-28.

[24] K. D. Kulkarni, G. Noel, & D. N. Kulkarni. (1996). Sorghum malt-based weaning food formulations: preparation, functional properties and nutritive value. *Food and Nutrition Bulletin*, 13 (4): 322-327.

[25] W. O. Ellis, I. Oduro, J. Barimah, & J. A. Otoo. (2003). Quality of starch from six Japanese sweet potato varieties in Ghana. *African Journal of Root, Tuber and Crops,* 5(2): 38-41.

[26] I. Oduro, W. O. Ellis, L. Nyarko, G. Koomson, & J. A. Otoo, Physicochemical and pasting properties of flour from four sweet potato varieties in Ghana. Proceedings of the Eigth Triennial Symposium of the International Society for Tropical Root Crops (ISTRC-AB), Ibadan, Nigeria., 2001.

[27] R. C. Baker, P. Wonghan, and K. R. Robbins, Fundamentals of new food products developments. Science, Volume 16. Elsevier Science Amsterdam, 1994.

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