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Effect of Sprouting on Cookability of Cocoyam Tubers and Physicochemical Properties of Cocoyam Flours

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Abstract: The effect of sprouting on the cookability of cocoyam tubers was investigated. Cultivars of *Xanthosoma sagittifolium* and *Colocasia esculenta* were planted. The planted tubers were unearthed after every 2 days and their cooking time determined until complete sprouting was observed. The planted cocoyam tubers were also dried and ground into cocoyam flour after being unearthed every other day. The water absorbtion, oil absorbtion and gelation temperature of these cocoyam flour samples were also determined. The cooking time for all cultivars increased with increase in the days of sprouting. It was observed that all the cocoyam cultivars could no longer cook after full sprouting was observed which occurred within 8-12 days from the day of planting. Physicochemical properties of the cocoyam flour as affected by days of sprouting also showed that gelation temperature increased while water and oil absorption decreased with increase in the days of sprouting.

Key words: Cocoyam, plant, tubers, flour, oil

INTRODUCTION

Cocoyams (*Xanthosoma sagittifolium* and *Colocasia esculenta*) are tropical root crops which belong to the Araceae family. It is grown in Nigeria and in many other parts of the tropics and sub-tropics of Africa. (Sefa-Dedeh and Agyir-Sackey, 2004; Iwuoha and Kalu, 1995; Purseglove, 1972; Irvine, 1969; Vickery and Vickery, 1979). Cocoyam corms and cormels are usually eaten boiled, roasted, pounded and sometimes mixed with other staples such as yam, cassava or plantain. It is widely used as soup thickner and usually pounded to a soft dough known as utara ede in South Eastern Nigeria (Ihekeronye and Ngoddy, 1985; Onwueme, 1978; Obiechina and Ajala, 1987). The estimated world production of cocoyam is placed at 5.5 million tones annually (FAO, 1991) with Ghana and Nigeria being considered as the world's leading producers (Sefa-Dedeh and Agyir-Sackey, 2004; Onwueme, 1978).

Cocoyam is nutritionally superior to other roots and tubers in terms of digestible crude protein and minerals such as Ca, Mg and P (Chukwu *et al*., 2008; Green, 2003; Gooding, 1987). Cocoyam also possesses the smallest starch grain size relative to other root crops and tubers (FAO, 1990). This makes cocoyam a suitable food for potentially allergic infants, persons with gastro intestinal disorders as well as diabetic patients (FAO, 1990).

One of the problems facing cocoyam is post harvest storage (Chukwu *et al*., 2008). Cocoyams can be best stored in cool, dry, well ventilated surroundings. The best temperature for prolonged storage is about 7°C. At this temperature, tannia in Trinidad and Taro in Egypt did not deteriorate in storage for over 3.5 months (Kay, 1973; Hashad, 1956; Onwueme and Charles, 1994). Storage at lower temperatures leads to death of buds and decay of the corms within 2 months while storage at higher temperatures such as 15-23°C is not satisfactory for long periods (Onwueme and Charles, 1994).

Storage of cocoyams at temperatures around 7°C is not possible for local farmers and consumers in Africa because of the peculiar high temperature associated with the tropics hence in many African countries like Cameroun, Egypt and Sonea, cocoyam is stored in underground pits (Onwueme and Charles, 1994). In some communities in Southeast Nigeria, cocoyam is stored by being buried under the earth in a cool environment or swamp (Chukwu *et al*., 2009). This storage of cocoyams under the earth in a cool dry ventilated surrounding or swamp results in the sprouting of the corms at the availability of some level of moisture.

Sprouting which is one of the avenues of high physiological losses is characterized by increased enzymatic activities resulting to breakdown of macromolecoules and mobilization of reserves from the corm to the growing shoot which in turn depletes the food nutrients stored in the corm. Nwufo and Atu (1987) reported 50% losses. After 2 months of storage and about 95% after 5 months as a result of sprouting. To reduce losses due to sprouting, some farmers practice in situ storage and harvest piece meal to meet consumption and commercial needs. This system ties up the land and restricts use for other purposes (Mbanaso *et al*., 2007; Chukwu *et al*., 2009). These processes that take place during sprouting result in the reduction of the eating quality of cocoyam, making them unavailable for consumption, processing and marketing (Nwufo and Atu, 1987).

In all the different ways cocoyam is being consumed traditionally whether by boiling, pounding as a soup thickner, etc., softening of the cocoyam tuber when cooked is a critical factor which is used to determine its degree of doneness (cookability). However, cocoyams in their various local places of storage usually sprout after some period of time. This sprouting has been observed to affect its cookability and hence its utilization thus sprouted corms and cormels of cocoyams sre used as planting materials rather than eatable materials. This problem reduces the economic value of the sprouted cocoyam and renders farmers economically disadvantaged.

Thus, in this study, the effect of sprouting on the cookability of cocoyam tubers was quantitatively investigated in addition to its effect on some physicochemical properties of cocoyam flour.

MATERIALS AND METHODS

Preparation of the materials: Four cultivars of cocoyam tubers locally known as Coco India, Ede ofe, Ede Ocha and Ede Uhie were obtained from the main market in Owerri, Southeast Nigeria. The cocoyam cormels were identified in the Department of Crop Science and Technology, Federal University of Technology, Owerri, Nigeria. Coco India and Ede Ofe were identified as *colocasia esculenta* while Ede Ocha and Ede Uhie were identified as belonging to the *Xanthosoma sagittifolium*. The cormels were carefully selected to remove all cormels with any form of defect or sign of sprouting.

A portion of land consisting of moist rich loamy soil was cleared and tilled into flat beds. The beds were divided into four sections and each cultivar was planted in each section, respectively. Samples of the planted cultivar were taken every 2 days to determine cookability and further be processed into flour for determination of physicochemical properties. This continued until complete sprouting occurred. Here, complete sprouting is taken to have occurred when the cocoyam sprout produces a complete leaf.

Determination of cookability: The cookability was determined by the cooking time taken to achieve softness. About 600 g of each cultivar (not planted) was measured out on the 0 day of planting. They were peeled and sliced separately into cubes of about 1 cm thickness. About 200 g of cocoyam slices of each cultivar were separately and sequentially placed into an aluminum pot (with a tight fitted cover) of diameter 18.3 cm and depth 8.6 cm. The 400 mL of water at ambient temperature of about 28°C was poured into the pot to completely cover the cocoyam slices. The cooking was done using a gas stove with a transparent light blue flame whose power was estimated to be about 225 W. The gas stove was left in this state unadjusted throughout the experiment. A stop clock was switched on at the same time the pot was placed on the gas stove. The cooking time was determined as the time interval from the time the pot of sliced cocoyam was placed on the stove to the time the cocoyam slices were cooked. The cocoyam slices were considered cooked when they could easily be mashed under slight pressure between fingers (Bede, 2007). To determine when the cocoyam slices were cooked, a sensory panel of five people who were familiar with the cooking of cocoyam were used. For the tests. Two slices of each boiled cultivar per panelist were used to test for softness. Preliminary cookings for each cultivar was carried out to determine times when softening of the slices were to be expected. As a result of the preliminary cooking, the pot was opened once or twice to test for the softening of the cocoyam slices. The experiment was repeated for the planted cocoyam cultivars which were uprooted at an interval of 2 days until sprouting was completed.

Determination of physicochemical properties: About 200 g each of the different cocoyam cultivars were weighed out, peeled and sliced into thin sizes ranging from 2.0-2.5 mm on the day of planting considered as the 0 day. The sliced cocoyam chips were sundried completely and was ground to flour in an attrition mill. The flour was then packaged in an air tight container for subsequent analysis. The planted cocoyam cultivars were uprooted every other day until complete sprouting of the cocoyam. This procedure for producing flour was repeated for the cocoyam cultivars the days they were uprooted.

Determination of water absorption capacity: The water absorption capacities were determined by the procedure as described by Onwuka. About 1 g of ground cocoyam flour sample was mixed with 10 mL distilled water for 1 min by manual shaking. The mixture was then allowed to stand at room temperature for 30 min. The volume of the supernatant in a 10 mL graduated cylinder was noted and converted to weight by multiplying with the density of water. The water absorption capacities were expressed as gram of water absorbed per gram of ground sample.

Determination of oil absorption capacity: The oil absorption capacity was determined by the procedure described by Onwuka. Here, 1 g of ground cocoyam flour was mixed with 10 mL of bleached deodorized vegetable oil for one minute by manual shaking. The mixture was then allowed to stand at room temperature for 30 min and then centrifuged at 1500 rpm for 30 min. The volume of the supernatant in 10 mL graduated cylinder was noted and converted to weight by multiplying with the density of oil. The oil absorption capacity was expressed as mass of oil absorbed per gram of ground cocoyam sample.

Determination of gelation temperature: The gelation temperature was determined by the procedure described by Onwuka. About 5 g of cocoyam flour sample was put into a beaker. About 50 mL of water was added into the powdered cocoyam and then stirred gently. The beaker containing the mixture was placed on the heater and heated until it started gelling. The temperature at which it started gelling was recorded. This is the gelation temperature.

RESULTS AND DISCUSSION

Two cultivars of *Colocassia esculenta* and two cultivars of *Xanthosoma sagittifollium* were used in this research. The cultivars of *Colocassia esculenta* used for this research are locally named coco india and ede ofe and were referred to in this research as taro1 and taro2, respectively. The cultivars of *Xanthosoma sagittifolium* used are locally called ede uhie and ede ocha which were referred to as tania1 and tania2, respectively.

Figure 1 shows the effect of sprouting on the cooking time of the different cocoyam cultivars. Figure 1 shows that for all cultivars of cocoyam studied, there was increase in the observed cooking time within 2 days of planting. It was observed that all the cultivars could cook to softness until they attained complete sprouting after which they could no longer cook. Taro1 achieved full sprouting by the eight day and could no longer cook after the eight day while taro2 could cook up to the 10th day when it was observed to have achieved complete sprouting. After the 10th day, taro2 could no longer cook. Tania2 could cook up to the 12th day when complete sprouting was observed while tania1 achieved complete sprouting by the 10th day and could no longer cook after the 10th day. Table 1 shows that sprouting had more effect on the cooking time of the tanias than the taro variety. At about the time full sprouting was achieved the cooking time for tanias has increased by an average of 76.5% while for taros the cooking time increased by an average of 71%. The studies showed that the cocoyam cultivars could no longer cook after 8-12 days of sprouting depending on the variety, especially when full sprouting has been achieved. The increase in the cooking time may be due to the reduction in active starch molecoules which were used up during the sprouting process.

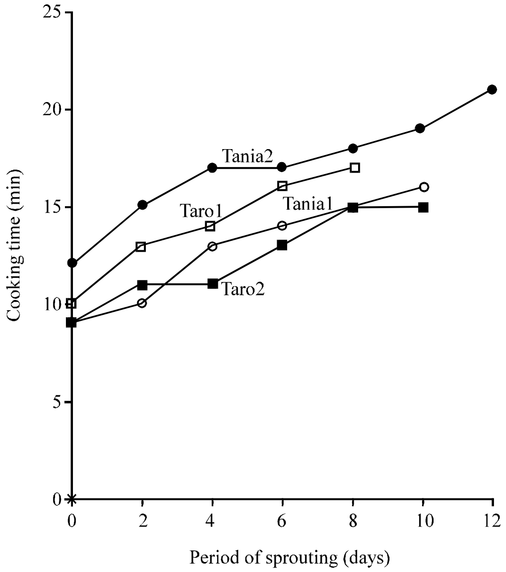

Fig. 1: Variation of cooking time with period of sprouting for different cocoyam cultivars. The taro1 and taro2 represent two varieties of *colocassia esculenta* while tania1 and tania2 represent two varieties of *Xanthosoma sagittifolium*

Figure 2 shows how the gelation temperature for the flours produced from the cocoyam cultivars varied with days of sprouting for the cocoyam cultivars. The gelation temperature was increasing with days of sprouting. Taro1 and taro2 showed similar trend in the increase of the gelation temperatures and the same was the case of tania1 and tania2. The increase in the gelation temperature for the cocoyam cultivars may be due to the breakdown and depletion of the carbohydrate molecoules due to sprouting process. The average percentage increase in gelation temperature at full sprouting for the taros (*Colocasia esculenta*) were almost the same for the tanias (*Xanthosoma sagittifolium*).

The variation of water absorption of the cocoyam cultivar flours with increasing days of sprouting is shown

Table 1: Percentage reduction or increase in values of properties at full sprouting

Type of cocoyam	Increase in cooking time (%)	Increase in gelation temp (%)	Reduction in oil absorption (%)	Reduction in water absorption (%)
Taro1	70	24	31	23
Taro2	72	27	25	23
Tania1	78	30	39	33
Tania2	75	21	45	40

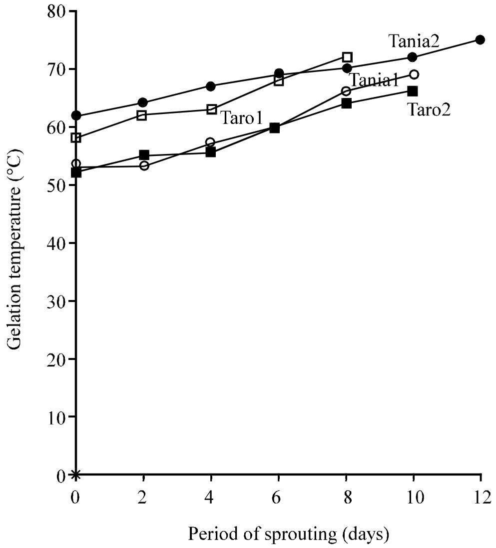

Fig. 2: Variation of gelation temperature with period of sprouting for different cocoyam cultivars. Taro1 and taro2 represent two varieties of *colocassia esculenta* while tania1 and tania2 represent two varieties of *Xanthosoma sagittifolium*

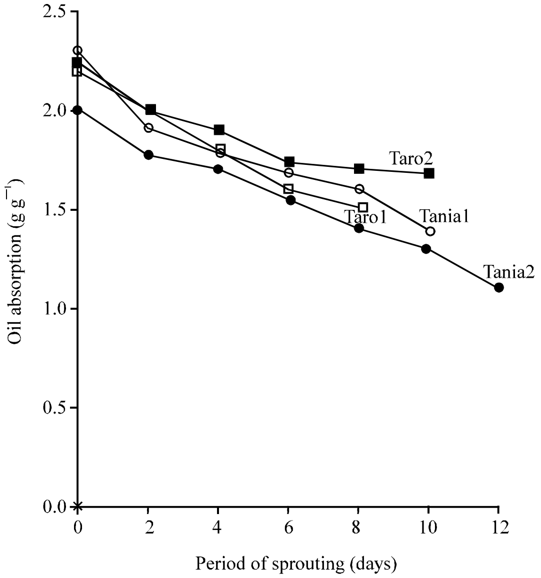

Fig. 3: Variation of oil absorption with period of sprouting for different cocoyam cultivars. Taro1 and taro2 represent two varieties of *Colocassia esculenta* while tania1 and tania2 represent two varieties of *Xanthosoma sagittifolium*

in Fig. 3. All the cultivars showed decrease in water absorption with increase in the days of sprouting. Tania2 showed the least water absorption capacity at full sprouting. This may suggest the reason why it had the highest cooking time among the cultivars as cookability is dependent on water absorption. The decrease in carbohydrate molecoules as a result of sprouting activities could have resulted in the reduction of the amount of water absorbed by the flour samples.

The cultivars of *Xanthosoma sagittifolium* (Tania1 and tania2) showed similar trend in their oil absorption capacity as the days of sprouting increased (Fig. 4). For the *Colocassia esculenta* cultivars, taro1 showed lower oil absorption than taro2. In general, the results obtained were in line with earlier research which showed that sprouting has significant effect on the chemical, functional and pasting properties of flours produced from sprouted grains and nuts (Chinma *et al*., 2009; Hussain and Uddin, 2012).

Cocoyam is traditionally used as a thickener. When a food thickener is added to a beverage, it absorbs the fluid and the food thickens. Reduction in water and oil absorption in the cocoyam flours due to sprouting

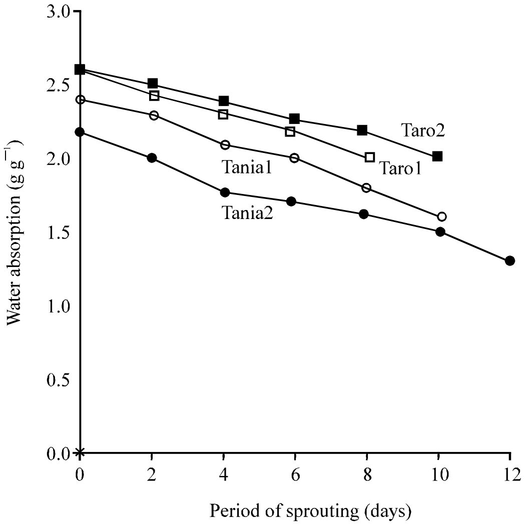

Fig. 4: Variation of water absorption with period of sprouting for different cocoyam cultivars. taro1 and taro2 represent two varieties of *Colocassia esculenta* while tania1 and tania2 represent two varieties of *Xanthosoma sagittifolium*

indicate that sprouting reduces its thickening power. However, from Table 1, the relatively low percentage reduction in water and oil absorption of about 28 and 23%, respectively in taro and about 42 and 36.5%, respectively in Tania on the average suggest that it could still be possible to use the flour of sprouted cocoyam tubers especially the taros as an alternative soup thickener to freshly prepared cocoyam dough for traditional delicacies.

CONCLUSION

Sprouting affects the cookability of cocoyam cultivars. This invariably affects their utilization for local uses and delicacies. The flour produced from the corms and cormels of sprouted cocoyams showed relatively low percentage reduction in water and oil absorption. The use of cocoyams as thickeners depends on their cookability which is adversely affected by sprouting. Cocoyam flours of sprouted cocoyams could still be used as an alternative thickener in place of the traditional cooked and pounded cocoyam as the flour still showed pronounced ability to absorb water and oil.

REFERENCES

Bede, E.N., 2007. Effect of quenching on cookability of some food legumes. Food Control., 18: 1161-1164.

Chinma, C.E., A.O. Adewuyi and J.O. Abu, 2009. Effect of germination on the chemical, functional and pasting properties of flour from brown and yellow varieties of tigernut (*Cyperus esculentus*). Food Res. Int., 42: 1004-1009.

Chukwu, G.O., K.I. Nwosu, J. Onyeke and R. Asiedu, 2008. Cocoyam rebirth in Nigeria. Proceedings of the 1st International Workshop on Cocoyam, October 29-31, 2008, IRAD, Ekonna, Cameroon.

Chukwu, G.O., K.I. Nwosu, T.U. Madu, C. Chinaka and B.C. Okoye, 2009. Development of gocing storage method for cocoyam. Munich Personal RePEc Archive, Paper No. 17444. http://mpra.ub.uni-muenchen.de/17444/.

FAO, 1990. Roots, Tubers, Plantains and Bananas in Nutrition. FAO, Rome, Italy.

FAO, 1991. Quarterly Bulletin of Statistics. Vol. 4, Food and Agricul-ture Organization of the United Nations, New York, USA.

Gooding, E.G.B., 1987. Root Crops. TDRI, London, pp: 223-233.

Green, B.O., 2003. Taxonomic and nutritional analysis of certain tuber crops in the Niger Delta of Nigeria. Afr. J. Environ. Stud., 4: 120-122.

Hashad, M.N., 1956. Transformation of carbohydrates in taro corms during storage. Ann. Agric. Sci. Fac. Agric. Ains Shams Univ. Cairo, 1: 269-276.

Hussain, I. and M.B. Uddin, 2012. Optimization effect of germination on functional properties of wheat flour by response surface methodology. Int. Res. J. Plant Sci., 3: 031-037.

Ihekeronye, A.I. and P.O. Ngoddy, 1985. Cocoyams. In: Integrated Food Science and Technology for the Tropics, Ihekeronye, A.I. and P.O. Ngoddy (Eds.). Macmillian, London, UK., pp: 280-281.

Irvine, F.R., 1969. Cocoyam. In: West African Crops, Irvine F.R. (Ed.). Oxford University Press, Oxford, UK., pp: 174-179.

Iwuoha, C.I. and F.A. Kalu, 1995. Calcium oxalate and physiochemical properties of cocoyam: *Colococasia esculenta* and *Xanthosoma sagitifocium* tuber flours as affected by processing. J. Food Chem., 54: 61-66.

Kay, D.E., 1973. Crop and Product Digest 2: Root Crops. Tropical Product Institute, London, Pages: 245.

Mbanaso, E.N.A., B.C. Okoye, M. Obasi and S.U. Nwoko, 2007. Effect of air curing on shelf life in cocoyam planting materials stored in soil pits. Proceedings of the 41st Conference of the Agriculture Society of Nigeria (ASN'07), Ahmadu Bello University Zaria, pp: 391-392.

Nwufo, M.I. and U.G. Atu, 1987. Post harvest rots of cocoyam. Proceedings of the 1st National Workshop on Cocoyam, August 16 -21, 1987, NRCRI, Umudike, Nigeria, pp: 152-156.

Obiechina, O.C. and A.A. Ajala, 1987. Socioeconomic and cultural importance of cocoyam as a Staple food. Proceedings of the 1st National Workshop on Cocoyam, August 18-21, 1987, Umudike, Nigeria, pp: 180-184.

Onwueme, I.C. and W.B. Charles, 1994. Tropical root and tuber crops: Production, perspectives and future prospects. FAO, Rome, pp: 115-135.

Onwueme, I.C., 1978. Colocasia and Xanthosoma. In: The Tropical Tuber Crops, Onwueme, I.C. (Ed.). John Wiley and Sons, New York, USA., pp: 199-227.

Purseglove, J.W., 1972. Araceae. In: Tropical Crops: Monocotyledons, Purseglove, J.W. (Ed.). Halsted Press Division, Wiley, Essex, UK., pp: 58-74.

Sefa-Dedeh, S. and E.K. Agyir-Sackey, 2004. Chemical composition and the effect of processing on oxalate content of cocoyam *Xanthosoma sagittifolium* and *Colocasia esculenta* cormels. Food Chem., 85: 479-487.

Vickery, M.L. and B. Vickery, 1979. Plant Products of Tropical Africa. The Macmillan Press Ltd., London, pp: 116.