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# STORAGE METHODS AND SOME USES OF CASSAVA IN NIGERIA

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ABSTRACT
The storage of agricultural raw materials is an essential aspect of food processing that ensures that food remains available even in time of scarcity. The storage methods and some potential uses of cassava, which include its use in the productions of garri, farinha, attieke, cassava bread, chips, cassava powder for increasing the nutritional content of animal feed especially in beef cattle and for increasing the body weight of chicken were discussed. The production of ethanol fuel from cassava, for running automobile engines is also discussed in this paper. All these uses are capable of overturning the fortunes of many unemployed Nigerians to being productive and gainfully employed.

KEYWORDS: Storage, Cassava, uses, Nigeria.

## INTRODUCTION

Root and tuber crops are still living organisms after they have been harvested and losses that occur during storage arise mainly from their physical and physiological condition. The main causes of loss are associated with mechanical damage, physiological condition (maturity, respiration, water loss, sprouting), diseases and pests. To ensure effective storage of root and tuber crops, these major causative factors need to be properly understood and, where appropriate, be properly controlled, taking into account the socio-economic factors which prevail in the areas of production and marketing (FAO, 1985).

Root and tuber crops need to be handled gently to minimize bruising and breaking of the skin because of its relatively soft texture compared, for example, to cereal grains. The effect of mechanical injury resulting in external and internal bruising and tissue discoloration is often underestimated. Severely damaged tubers should not be stored for lower quality, increased risk of subsequent pathogenic losses and the risk of introducing disease organisms into sound produce reasons. Most mechanical damage occur as a result of careless handling at harvest and during transport to and within a store since, generally in the tropics, food handling procedures are poorly developed and fresh produce is all too frequently treated as an inert object (Cooke *et al.*,1988).

Careful harvesting and proper handling of roots and tubers is, therefore, an important step towards successful storage. Crops are most likely to be injured at harvest by the digging tools, which may be wooden sticks, machetes, hoes or forks. Therefore, immediately after harvest, the crops most undergo the operation of curing. The need for curing as a method of reducing the onset of disease is well known and the technique is becoming more widely understood and practiced (Booth, 1974).

The length of time for proper curing cannot be definitely stated as it depends on many factors, such as condition of the crop at harvest, type of wound, season, storage temperature and relative humidity. Cassava for example cures between 30-40°C temperatures, 90-100% relative humidity in just 4 days.

Roots and tubers have high moisture content which makes them difficult to store for any length of time. Also they are bulky and difficult to handle and transport to distant markets. With cassava these problems are increased by compounds of cyanide in the leaves and roots which have to be removed before they can be consumed. Over many years traditional processes have evolved which yield a more durable product and in many instances a more convenient product for domestic use. In many village communities root crops remain a staple and hence are often the main part of the meal. Village scale processing of root crops is therefore an important part of women's daily work (Cooke *et al.*, 1988).

Although many researchers from literature have worked on cassava root and its numerous postharvest applications, yet very little of these uses are being harnessed in Africa. This paper therefore focuses on the storage methods and some uses of cassava roots in Nigeria.

Improved Storage Methods for Fresh Cassava

During the last twenty years there have been some developments in improving storage methods capable of extending the shelf life of fresh cassava roots by at least two weeks. These, amongst other advantages, make it possible to market the crop further and give an increased margin to the opportunity of holding stocks of fresh cassava, even for few days, at a processing plant. A joint project between the National Resources Institute, and Centro Internacional de Agricultura Tropical studied alternative storage methods to the traditional re-burial procedures. These included storage in pits, in field clamps and in boxes with moist sawdust. All the storage methods investigated favoured curing conditions in a high humidity and high temperature environment in order to slow down the rates of physiological and microbiological deterioration. However, to be successful they all require careful harvesting and selection of the roots prior to storage, since curing is not effective if root damage is extensive (Cooke *et al.,* 1988; Crentsil *et al.*, 1995).

Storage in Field Clamp

Storage was successful in field clamps, similar to those used for potato storage, for up to eight weeks. The clamps consists of a layer of straw laid on a dry floor covered by a heap of 300-5000kg of roots followed by a layer of straw and a final layer of soil. Openings were left at the bottom of the heap to provide some ventilation. This storage method was found to be difficult to manage where seasonal variations in climate made it difficult to either limit or increase ventilation and, during a wet season, to ensure that the floor of the clamp remained dry. It also had a high labour requirement (Crentsil *et al.*, 1995).

Storage in Boxes Lined with Moist Sawdust or Wood Shavings

The method involves putting alternative layers of sawdust and cassava roots, starting and finishing with a layer of sawdust. As an alternative to sawdust, wood shavings or any other suitable packing material can be used. However, the packing material must be moist but not wet. Physiological deterioration occurred if the material was too dry and microbial decay accelerated when it was too wet. In Uganda this storage method is being tested in combination with the lining of box with plastic (Nahdy and Odong, 1995).

The study indicated that 75% of the roots remained healthy after four weeks in store, provided the roots were packed immediately on the day of harvest. With a delay of one day only 50% of the roots were rated as acceptable. This technique has been used for some export markets but the higher transport cost involved because of the box containers has precluded its use for domestic market.

Storage in Plastic Bags or Plastic Film Wraps

This appears to be the most practical and promising method of storing cassava roots intended for the urban markets. A number of studies have shown that cassava roots treated with an appropriate fungicide and kept in an airtight plastic bag or a plastic film wrap can be stored for two to three weeks. At present thiabendazole, this is widely used to treat potatoes, is the safest and most appropriate fungicide to be used. Only 1mg/kg of residue was found in the parenchyma tissue, which is substantially below the limit of 5mg/kg set for potato (Cooke *et al*., 1988).

The method was developed by CIAT. It involves the dipping of cassava roots in a 0.4% w/w solution of thiabendazole for 10 seconds and storing in plastic bags. It has been successfully tested in Ghana where it was found that household bleach (0.95% active chlorine) was as effective as thiabendazole if sound cassava roots were not stored for much longer than seven days. In addition, transport of the produce over rough roads seemed not to be detrimental to the keeping quality of the roots, suggesting the technology could be effective for commercial operations.

Improved Higher Cost Technology

Some modern methods, such as refrigeration, deep freezing, waxing, controlled atmosphere and chemical treatments, have been suggested for the storage of fresh cassava. Freezing and waxing have been used primarily for export markets in Europe and America, where the customers of African and Latin American origin are prepared to pay high prices. These techniques require specialized equipment and skills and are very capital intensive (Crentsil *et al.*, 1995).

Uses of Cassava

The following are some of the uses of cassava considered:

The Production of Garri

Garri is regarded as fermented and gelatinized dry coarse flour, very popular in West Africa and a staple food in Nigeria, Ghana, Benin and Togo. Its ability to store well and its acceptability as a “convenient food” are responsible for its increasing popularity in urban area of West and Central Africa. It is often consumed as the main meal in the form of dough or a thin porridge. Both are prepared in the household by mixing dry garri with hot or cold water and cooking and are served with stew or soup. Garri is eaten as a snack when mixed in cold water with sugar, and sometimes milk. It swells three to four times its volume when mixed with cold water.

The traditional production of garri is a long and tedious process. Five distinct operations are required. These are peeling, grating, fermentation and pressing, sieving, frying and drying. The operations are traditionally carried out by women, usually starting very early in the morning harvesting, peeling and washing the roots in the field, then carrying the cleaned roots to the village where the rest of the operations are carried out. A summary of the losses incur in material during operations and their corresponding moisture contents are presented in Table 1.

Table 1: Operations in the production of garri and the losses incurred at each operation from an initial 100kg of fresh unwashed roots.

| Operations | Loss of Material | Residual MC % |
|---|---|---|
| Peeling and Washing | 27kg peel | 70 |
| Grating | 3kg | 70 |
| Pressing/Fermentation | 30kg | 96 |
| Sieving | 1kg | 50 |
| Frying/Drying | 17kg | 8 |
| Residual Garri | 22kg | - |

Cock, 1985

The production of Chips

The cassava roots are peeled immediately after harvesting with the traditional cutting tools, e.g. brushwood knife (machete). The peeling, mainly carried out manually by women, requires a great deal of work. One woman can peel about 20 -25 kg roots in one hour (Sadik, 1987). The loss in weight occurring due to peeling amounts to about 30% of the fresh weight (ibid.). Various peeling machines have been developed in West Africa. These have not been widely accepted because the purchase prices are too high and the machines cause too great a loss in peeling (ibid.).

The roots peeled are then washed. If the chips are obtained from bitter cassava varieties, the roots are kept in water after peeling. This causes hydrogen cyanide to be released, reducing the danger of poisoning (Jakubczyk, 1982). For a sufficient release of hydrogen cyanide, the roots should be soaked for 2 - 4 days. A good release of hydrogen cyanide is attained if the roots are cut into pieces prior to soaking. These are then soaked in water for 15 minutes and then boiled for 2 minutes (Jakubczyk, 1982).

Another method of preparation is to briefly boil the freshly peeled roots in water. Then they are halved lengthwise and soaked in water for 1 - 2 days. The water should be changed once to twice during this time (Onwueme, 1978).

Which process is preferred, particularly regarding the release of hydrogen cyanide, has not yet been sufficiently investigated. The cassava roots prepared in this way are cut into pieces for drying. How the roots are split up and how large the pieces are, vary from region to region and depend on consumer demand and on climatic conditions. Thus the pieces are mostly larger in the dry northern parts of Ghana than those in the south of the country. In some cases the cutting of the roots has also been mechanized. The machines used for this chip cut the roots into small pieces which dry correspondingly well (Cock, 1985).

The production of *farinha de mandioca*

*Farinha de mandioca,* as it is called in Brazil, is a processed cassava product particularly popular in the north-east of the country. Originally it was a food product developed over several centuries by the Indians of tropical America as a process for detoxifying bitter cassava and storing it for longer periods than was possible with fresh cassava. It is a product quite similar to garri, with the same individual operations involved in its production except that the fermentation time is shorter. There are indications that garri production was introduced in Africa by freed slaves returning from Brazil, bringing the knowledge of *farinha de mondioca* production with them.

The traditional technology of *farina* production has developed in line with the need to feed a rapidly growing urban population. The Portuguese introduced machinery which adapted well to them traditional system, notably for the grating and pressing operations. Now in Brazil, two distinct *farinha* production systems coexist, *farina grossa* and *farina d'agua.* Both processes are essentially the same except that in the latter the roots are submerged in pools of water for several days before peeling (Cock, 1985).

The Production of Cassava Bread

Cassava bread, which is also called *cassava* in the francophone Caribbean countries and *casaba* in Spanish Caribbean countries, is a white, flat, circular, porous food product made by baking moist cassava mash. It is a very popular food in Spanish and Central America and the Caribbean.

The bread is made by spreading a layer of non-fermented cassava mash, produced in the same process as garri, (peeling fresh roots, grating, pressing and sieving but not fermented), over a heated metal or ceramic plate and baking it on both sides at a temperature of about 160°C. some processors sprinkle cassava mash on the metal plate and if it turns brown, then it is considered to be at the proper temperature. After baking the fresh cassava bread is sun-dried on raised platforms for few hours to improve its keeping quality, before packed in paper or polyethylene bags for marketing, which is frequently sold in the retail market directly from the bakers and trader vehicles. Some processors may add salt and peanut paste or garlic before baking (Carrizales, 1991).

The Production of Attieke

Attieke is a fermented and gelatinized cassava meal which has its origins in the south of Cote d'Ivoire, but which is now the most popular cassava product in the country. In 1984 the consumption of attieke in Abidjan alone was estimated at 70-80 tons per day and the market demand has continued to grow at a considerable rate. The demand is largely met by an army of thousands of women processors and traders. Attieke is generally consumed with meat, incorporated into a vegetable sauce or mixed with milk.

The operations involved in its production are essentially the same as for garri; peeling and washing, chopping (into 3-4cm cubes), mashing or grating, fermenting, de-watering, sieving, granulating, drying and steaming. The production process is very long and at times tedious, most of the operations at present still being done by hand except for mashing.

Production of Ethanol from Cassava

Scientific interest and efforts in researching into renewable energy technologies are still relevant, especially in view of the often very high costs of conventional energy supply worldwide. Another reason for their relevance is the fact that the rampant use of firewood for domestic and industrial heating in low income countries invariably necessitates the destruction of forests and this is harmful to the environment. Renewable technologies rely principally on plant and animal materials as their feedstock, of which the most dominant among the plant materials are the energy crops.

An energy crop is a plant grown at a low cost and low maintenance harvest used to make biofuels, or directly exploited for its energy content. Conventional energy crops include sugarcane and cassava crop.

Ethanol fuel is ethanol (ethyl alcohol), the same type of alcohol found in alcoholic beverages. It can be used as a fuel, mainly as a biofuel alternative to gasoline, and as an oxygenate to gasoline in the United States. Together both countries were responsible for 89% of the word's ethanol production in 2008 (Lincht, 2009).

There are two common strategies of producing liquid and gaseous agrofuels. One is to grow crops high in sugar (sugar cane, sugar beet and sweet sorghum) or starch (maize, cassava, yam), and then make use of yeast fermentation to produce ethyl alcohol (ethanol) (ICRISAT, 2009). The second is to grow crop that contain high amount of vegetable oil, such as oil palm, groundnut, soybean, castor oil, jatropha and rubber seeds. When these oils are heated, their viscosity is reduced, and they can be burnt directly in a diesel engine, or they can be chemically processed to produce fuels such as biodiesel. The chemistry of the process basically involves the fermentation of sugars into ethyl alcohol, carbon dioxide and the production of heat as shown in the equation

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$$

The basic steps for large scale production of ethanol are: microbial fermentation of sugars, distillation, dehydration and denaturing (optional) to render the ethanol unsuitable for human consumption. Enzymes are used to convert starch into sugar (Green Car Congress, 2005). Ethanol is produced by the microbial fermentation of the sugar. For the ethanol to be useful as fuel water must be removed. Most of the water is removed by distillation, but the purity is limited to 95- 96% due to the formation of a low boiling water ethanol azeotrope. Ethanol is most commonly used to power cars, although it may be used to power other vehicles, such as farm tractors and airplanes.

Brazil has already started producing bio-ethanol from cassava. Many African countries are now becoming major producers of bio-ethanol. Cassava mutants could be developed to produce value-added biomass for cost-effective production of bio-ethanol.

Other Uses of Cassava

The following are some other uses of cassava crop:

a. Liu and Zhuang, 2010 have found out that cassava powder when incorporated into animal feed can be use to fatten beef cattle and to increase the body weight of chicken.

b. The leaves are high in amino acid, even higher than that contained in soybean cake and fish meal and hence are a good protein source.

c. Adelekan, 2010 has revealed that cassava crop is a sustainable source in the production of ethanol fuel for the supply of energy. In another version of this revelation, Aisien *et al.*, 2005 has shown that blending of ethanol produced from cassava waste water with gasoline can run automobile engine.

## CONCLUSION

The problems of unemployment facing the nation today can be addressed with these uses of cassava fully exploited by establishing agro based industries that can work on the crop and provide job opportunities for the teaming unemployed youths. The prospects of cassava are indeed numerous and promising.

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