

TRADITIONAL AND MODERN STORAGE METHODS OF UNDERGROUND ROOT AND STEM CROPS IN NIGERIA¹

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Resumen

El presente trabajo muestra varios métodos modernos y tradicionales de almacenamiento de cosechas de raíces recientemente cosechados, tales como yuca, camote, y otros tallos de cultivo bajo tierra, entre ellos ñame, tiquisque, patata blanca, jeníebre, cebollas y ajos. No obstante que algunos métodos modernos están disponibles para el almacenamiento de estas cosechas, los métodos tradicionales son extensamente practicados entre los agricultores.

Se analiza, por tanto, las ventajas y desventajas existentes entre los métodos tradicionales y modernos de almacenamiento.

Introduction

Underground root and stem crops provide some of the major staple foods of the total population in Nigeria. This has resulted in increased production of these crops, which in turn demands efficient and long-lasting storage techniques to protect the freshly harvested crops from spoilage. Consequently, improved storage techniques have been established in Nigeria. The purpose of the establishment of research institutes such as the "West African Stored Products Research Unit" (WASPRU) is to investigate the best methods for storing agricultural products to supplement or improve the existing storage methods among farmers (6).

In Nigeria, harvested crops are often slow to reach the markets or the consumer due to lack of immediate transportation from the farm sites. The need for lengthy storage also arises due to the seasonal production of these crops, which must be retained for food during the off-season and in times of scarcity, and also for use as seeds to plant in the following season.

Therefore efficient short-and long-term storage methods are practised by the farmers. The nature and final use of these farm products also determine the method and length of storage.

Various traditional and modern storage techniques are practised in the country, depending on technical know-how, facilities available, cost, climatic factors at the time of storage, risk of exposure to pest attack and the quantity of the farm produce. Although modern techniques are being developed for effective storage of these products in large quantities, most farmers still depend on the traditional methods since these new techniques are not within their reach. This paper documents the various storage techniques (traditional and modern) practised in various parts of Nigeria. The major root crops cultivated in the country are cassava (*Manihot* sp.) and sweet potato (*Ipomoea batatas*), while underground stem crops are yam (*Dioscorea* sp.), cocoyam (*Colocasia* sp., *Xanthosoma* sp.), potato (*Solanum tuberosum*), ginger (*Zingiber officinale*), onion (*Allium cepa*), and garlic (*Allium sativum*). Usually for all the underground stem and root crops, the soil particles are removed before storage to prevent and diseases caused by microorganisms.

Storage of these crops usually begins after harvest. Crop harvest periods vary depending on the type of

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crop, but usually storage lasts until the next harvest. Temperatures and relative humidity (RH) also vary between the two seasons (dry and rainy). The temperature during the storage period in the dry season varies from 28°C to 40.5°C, with the RH ranging from 33% to 78%. In the rainy season, the temperature varies from 21.1°C to 32.9°C, and the RH from 61% to 98%.

Root crops

1 Cassava (*Manihot* sp.)

Traditional Method of Storage

- (i) It is generally believed that cassava tubers cannot be stored satisfactorily once they have been harvested. With this belief in mind, farmers harvest the edible tubers before they become fibrous, while the others, which are used for starch and flour preparation, are left unharvested in the soil for a period of up to 2 years.
- (ii) For short-term storage, the tubers are carefully harvested with part of the aerial stem still attached (Fig. 1). This helps preserve the tubers in good condition, as the eventual decay starts at the cut end of the aerial stem. Similar observations have also been made by Irvine (3).
- (iii) The tubers are sometimes piled into heaps and watered daily to keep them fresh, or coated with a paste of mud to preserve their freshness for a maximum period of one week.

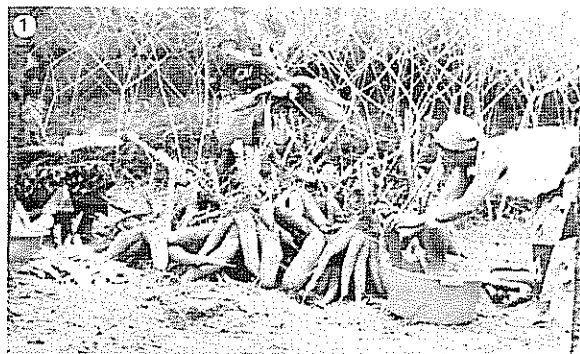


Fig. 1 Freshly harvested cassava tubers showing some portion of the aerial stem still attached

Modern methods

Recent research developments (1) have shown that the freshly harvested tubers can be stored for some time. The various modern methods practised at present are as follows:

- (i) The freshly harvested tubers, with a small part of the aerial stem still attached (Fig. 1), are buried in sawdust and kept moist by adding water every other day. This method helps preserve the tubers in good condition for a period of 2 to 3 months.
- (ii) For large scale storage, the tubers are kept in trenches where they are arranged between the leaves of oil palm or raffia palm and the trenches covered by a top layer of soil. The trenches are moistened with water at intervals and protected by a straw shed, which provides shade. This method has been found suitable for the storage of tubers for up to a period of 2 1/2 months.

2. Sweet Potato (*Ipomoea batatas*)

Traditional methods

Sweet potatoes are rarely stored in Nigeria, as they are harvested as required. However, various traditional methods of storage are used in different parts of the country for short periods.

- (i) The sweet potato tubers are arranged between layers of dry grass in shallow trenches. The topmost layer of dry grass is then plastered with mud.
- (ii) Selected healthy tubers can be stored in small rooms for about 2 to 3 weeks.
- (iii) In parts of northern Nigeria, the tubers are stored in dry sand-lined clamps, covered with grass, in shady places. They can be stored for 3 to 4 weeks.
- (iv) Tubers may also be stored in barns and are sometimes tied on racks covered with either dried grass or oil palm leaves. They can be stored for a maximum period of 3 weeks.
- (v) Sometimes the tubers are packed in bamboo baskets and stored in the roof space for a maximum period of one month.

- (vi) Storage at room temperature is also practised, although the tubers may lose 10% to 15% of their weight by two weeks after harvest (5)

Underground stem crops

1 Yam (*Dioscorea* sp.)

Traditional methods

Various traditional methods are used for the storage of yam in Nigeria

- (i) The stem tubers are stored on wooden platforms in cool and well ventilated rooms to avoid direct sunlight, which may cause drying and cracking. The tubers are arranged in irregular rows and covered with dry grass to allow air circulation.
- (ii) The yams are also stored by tying the tubers to a frame of living wooden poles (usually *Ficus* spp. since they are not easily attacked by termites) which are fastened together and anchored firmly into the ground. Cross poles are fastened to these upright poles at regular intervals, usually about 30 cm apart. The frames are set up in covered barns (Fig. 2). This is one of the best methods of preserving yams.
- (iii) Yam tubers are also stored in layers inside trenches. They are then covered with dry grass followed by a layer of soil. The trenches are normally made in areas where the soil is dry, in order to avoid sprouting and decay.

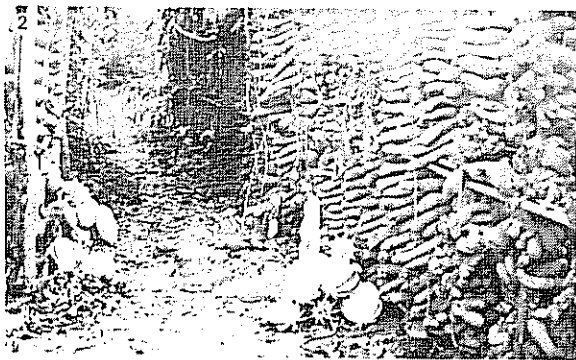


Fig. 2. Yam storage showing tubers tied to a framework of living wooden poles, e.g., *Ficus* sp.

- (iv) In some parts of Nigeria, yams are left in the soil for temporary storage after the stems have been cut off.

- (v) The tubers may be stored in a thatched shed with a raised platform about 0.6 – 0.9 m above the ground. The platforms, which are usually covered with oil palm leaves and branches, are supported by four corner poles.

- (vi) The tubers are packed in ashes and covered in soil before they are stored at room temperature.

- (vii) In some areas, the tubers are stored in pyramidal shapes lining the floor, and the clumps are covered with dried oil palm leaves, leaving a hole in the middle for air circulation.

- (viii) The yams are suspended singly from branches which shade them. This is practised with small quantities of yams.

- (ix) Seed yams are stored by slicing them into sets and removing the inside part of each one. These slices are put into shallow sheltered places in the ground and covered with plantain or banana leaves (*Musa* sp.). This enables them to produce sprouts and hastens their growth when planted. Most of these methods preserve the tubers for 6-8 months.

Modern methods

- (i) Cold room storage at about 15°C is being tried in research stations. This has been found expensive for traditional farmers (2).

- (ii) Yam tubers are irradiated with gamma rays at low dosages of 7.5-15 krad within one month of harvest. This is followed by storage in ambient conditions. This will effectively control factors causing deterioration and keep the yams in good condition for 8-9 months.

- (iii) The use of chemicals to prevent and control rotting of stored tubers is currently being tested and is showing good promise.

2 Cocoyam (*Colocasia* sp. and *Xanthosoma* sp.)

Traditional methods

- (i) Cocoyams are stored on wooden platforms with the corms arranged in irregular rows.

and covered with dry grass to allow air circulation

- (ii) In some parts of Nigeria, trenches are made in dry and shaded areas and the corms stored inside. They are covered with dry grass and finally covered with soil

So far, no modern methods of preservation of cocoyams have been used in Nigeria.

3 Irish Potato (*Solanum tuberosum*)

Traditional methods

- (i) Potatoes are usually stored in well-aerated bins or containers
- (ii) The tubers are also stored in loose and trussed straw and kept in well-aerated rooms

Modern methods

- (i) The traditional method of storing in bins and containers is improved by disinfecting the bins and containers with chemicals such as Formalin before storage.
- (ii) The loose and trussed straw method is also improved by using synthetic substitutes to remove excess moisture from surface layers of the tubers. Labor requirements are minimal
- (iii) A system of localised heating of the air space above the tuber stacks is also being practised for storage in warehouses with well-insulated roofs
- (iv) The incidence of sprouting and decay can be prevented or reduced by spraying a combination of CIPC (chloropropahm) and thiabendazole chloride on freshly harvested tubers (4)

These methods can preserve stored tubers for a maximum period of 6 months

4. Ginger (*Zingiber officinale*)

Traditional method

Roots and soil particles on the rhizomes are removed after harvest, and the ginger is stored in trenches of dried soil. The surface layer is covered with dry grass and finally with soil.

Modern method

The rhizomes are placed for 2-3 months in cold storage. The quality deteriorates with longer storage.

5. Onion (*Allium cepa*) and Garlic (*Allium sativum*)

Traditional method

The harvested bulbs are cleaned and the roots removed. They are left in the sun to dry thoroughly to prevent rotting during storage. They can store well for 3-4 months with occasional drying and removal of rotten bulbs

Discussion

It is well known that most of the developing countries have the necessary agricultural resources to supply their populations with food. In Nigeria, for example, the country is blessed with favourable physical and climatic conditions for the successful production of root and stem crops like cassava, sweet potatoes, yams, etc and various types of cereals. In Nigeria alone, 15 million tons of yams are produced per annum (1). The production of these crops, especially the food crops, is seasonal. Cassava cuttings are planted usually in the early part of the rainy season (May-June), and maturation of the roots takes from 9 months to 1 1/2 years depending on the variety, soil and rainfall. Sweet potatoes are planted during the rainy season, especially in April-May, and the growing period ranges from 3-5 months depending on the variety. Harvest takes place after 4-6 months. Yams in most parts of Nigeria are planted towards the end of the dry season (February-March) and are harvested at the end of the rainy season (September-October), while in some other parts especially in Central Nigeria, yams are planted at the beginning of the dry season (November-December) and remain dormant until the beginning of the rainy season (March-April), when they sprout. They are usually harvested at the end of the rainy season. Cocoyams (*Colocasia*), which take 5-6 months to mature, are planted at the end of the rainy season, while *Xanthosoma* takes about 10 or more months to mature after planting in the rainy season. Planting of Irish potatoes in the highland areas of Nigeria follows the same cycle as onion and garlic. They are planted about the middle part of the rainy season (July-August) in the northern parts of Nigeria, where there is low rainfall, and are harvested after 4-5 months. Ginger is planted in the beginning of the rainy season and harvested after 9-10 months.

Traditionally there has been no known method for long-term storage of cassava tubers, since they are easily susceptible to decay and also become fibrous a short while after harvest. The only methods therefore are short-term, and the most satisfactory method involves harvesting the tubers along with part of the aerial stem still attached to them. Modern methods can store these tubers up to a period of three months by burying them in sawdust or in trenches. Since this period of storage of cassava tubers is not long enough to cover the period until the next harvest, an efficient method should be developed through research efforts. Probably one of the drawbacks to research of freshly harvested tuber storage is the success already achieved in the preservation of tubers in their dried form for very long periods. The dried forms meet the needs of the people before the next harvest.

Various methods of storage for sweet potatoes are practised in Nigeria, although they are not satisfactory for long-term storage. As the tubers are consumed in their fresh forms, the need to store them in the dried form is neglected. Perhaps research on the utilisation of the dried forms may encourage farmers to store the tubers dry and thus eliminate wastage.

Yam is a traditional crop of West Africa, an area which accounts for three-quarters of world production. Traditional yam storage has been very satisfactory in Nigeria. Both short- and long-term storage methods have been found to preserve yams satisfactorily, probably because the tubers can be stored well in the fresh and the dried forms. There are many traditional practices and customs in storing yams, but the main objective is to keep the tubers dry and away from direct rays of the sun to avoid drying and cracking. The best and simplest traditional method, however, is that of preserving the yams on slatted platforms attached to living wooden poles (Fig. 2). This is because yams can easily be inspected, rotten yams can be removed, sprouts can be removed manually, and the method is easily available to farmers. Modern storage of yams is highly technical and beyond the reach of farmers. These methods, however, have very few advantages over the traditional methods, because both systems store for almost the same duration.

Crops such as cocoyams and Irish potatoes are secondary food items in Nigeria, and long-term storage has not received much attention. Moreover, they are always used in their fresh forms, and thus there is little concern for storage of the dried forms. However, researchers have evolved a modern storage technique for fresh Irish potatoes for up to a period of six months.

Only traditional methods for storage of onion and garlic are practised in Nigeria, and these have been found suitable among the people.

Dried ginger is used commercially as a spice in confections and mineral water manufacture (3). Little attention is thus given to long-term storage of the fresh forms.

In general, most of the underground root and stem crops are also stored in their dried forms. This paper has not attempted to discuss the various methods of dry preservation.

Summary

This paper documents the various traditional and modern storage methods of freshly harvested underground root crops, such as cassava and sweet potato, and underground stem crops, such as yams, cocoyams, Irish potato, ginger, onions and garlic. Although some modern methods are available for the storage of these crops, traditional methods are usually practised by farmers. The advantages and disadvantages of some of these traditional and modern methods of storage are discussed.

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Reseña de libros

SOTO M. Bananos, Cultivo y Comercialización. 1985. 627 p.

En este libro el autor vierte su conocimiento y experiencia adquiridas a través de muchos años, como profesional dedicado a la producción e investigación del cultivo del banano en Costa Rica y como profesor en la Facultad de Agronomía de la Universidad de Costa Rica.

El contenido del libro se distribuye en una secuencia adecuada en 10 capítulos, que incluyen además cuatros estadísticos, diagramas e ilustraciones fotográficas a color y en blanco negro, que tienden a mantener la atención del lector.

En el Capítulo 1 el autor hace una breve introducción sobre el origen y distribución del banano en el mundo, pasando luego a un amplio recuento histórico del cultivo y comercialización de banano en América, con énfasis en América Central y muy particularmente en Costa Rica.

El Capítulo 2 comprende la descripción botánica de la planta en sus diferentes partes haciendo énfasis en aquellos aspectos que pueden ser de utilidad para el manejo del cultivo. Se basa este capítulo en una extensa revisión bibliográfica matizada con experiencias propias del autor.

En el Capítulo 3 se hace una amplia exposición de la ecología del banano, con mucho énfasis en los factores climáticos y de suelos, que son relevantes para el cultivo.

El Capítulo 4 comprende la posición taxonómica, clasificación y mejoramiento genético. Nuevamente el autor en este capítulo se apoya en una extensa revisión bibliográfica, aunque incluye observaciones de experiencias propias realizadas en el área bananera costarricense.

Los Capítulos siguientes, 5 y 6, constituyen la parte medular del libro, desde el momento en que enfocan todas las operaciones del cultivo propia-

mente dicho, desde la siembra hasta la cosecha y empaque de la fruta. Se hace referencia inclusive a investigaciones recientes, cuyos resultados en algunos casos, aún no han sido publicados; aparte de experiencias propias del autor y de sus colaboradores.

El Capítulo 7 versa sobre el transporte y mercadeo de la fruta, en sus diversas fases, tales como el transporte al puerto de embarque, a los mercados; el almacenamiento, maduración y mercadeo de la fruta.

El Capítulo 8, muy relacionado con el anterior, comprende el Comercio, Economía y Política Mundial del banano, cubriendo aspectos de importancia como la demanda y oferta a nivel mundial, costos de producción y distribución, política bananera mundial y principales mercados del mundo. Se plantea también la posibilidad de comercialización directa de los productores y se ilustra con ejemplos en la materia.

El Capítulo 9 se dedica al aprovechamiento de la fruta "no exportable" en la elaboración de diversos productos para consumo humano, así como su utilización en la alimentación animal y finalmente en el uso de los desechos de la producción bananera.

El Capítulo 10 cubre el tema de la administración de una empresa bananera en sus diversas fases de planificación, organización, dirección y control.

Otros aspectos importantes del libro son la sección bibliografía al final de cada capítulo y el glosario de términos técnicos y uso bananero más corrientes, que en conjunto son de extrema ayuda al lector.

Finalmente, es necesario resaltar el enfoque que el Ing. Soto pretende dar a su libro, el cual lejos de ser teórico, presenta los diversos temas desde un punto de vista práctico, con miras a que en conjunto el libro sea de máxima utilidad para el estudiante académico, el productor e investigador de campo y el industrial bananero. Esto lo consigue el autor y por tanto la obra constituye un magnífico aporte a la literatura agrícola costarricense en particular, y una gran obra de referencia para la literatura "bananera" en general.

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