

# Storage, Preservation and Processing of Farm Produce

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## Introduction

Food preservation is the process of treating and handling food to stop or greatly slow down spoilage (loss of quality, edibility or nutritive value) caused or accelerated by micro-organisms. Some methods, however, use benign bacteria, yeasts or fungi to add specific qualities and to preserve food. Maintaining or creating nutritional value, texture and flavor is important in preserving its value as food. This is culturally dependent, as what qualifies as food fit for humans in one culture may not qualify in another culture.

Preservation usually involves preventing the growth of bacterial, fungi and other micro-organisms as well as retarding the oxidation of fats which causes rancidity. It also includes process to inhibit natural ageing and discolouration that can occur during food preparation such as the enzymatic browning reaction in apples which causes browning when apples are cut. Some preservation methods require the food to be sealed after treatment to prevent recontamination with microbes; others such as drying, allow food to be stored without any special containment for long periods.

Food preservation refers to any one of a number of techniques used to prevent food from spoiling. All food begin to spoil as soon as they are harvested or slaughtered, some spoiling is caused by such micro-organisms as bacterial and mold. Other spoilage results from chemical changes within the food itself due to natural process such as enzyme action or oxidation. For thousands of years humans have used methods of preserving food, so that they can store food to eat later. The simplest methods of preserving food, such as drying strips of fish or meat in the hot sun have been used for thousands of years and they are still used in the 2000s by indigenous people.

## THE PRINCIPLES UNDERLYING OF FOOD PRESERVATION

The art of food preservation is based on the following reasons:

1. Destruction of micro-organisms
2. Prevention of their entry into the food
3. Arrest or prevention of purely chemical reactions
4. Arrest of the action of food enzymes

## REASONS FOR PRESERVING FOOD

Foods are preserved for the following reasons:

- To prevent spoilage
- To avoid wastage, especially when they are in season
- To prolong its shelf life
- To allow for the use of foods during the off-season
- To eliminate the purchase of foods when they are most expensive
- To introduce variety in the family menu
- To be able to take care of emergency situations

## CAUSES OF FOOD SPOILAGE

Food spoilage is undesirable changes taking place in the food which eventually leads to its rejection. Food spoilage can be caused by the following factors.

- Action of insects
- Action of enzymes present in the food
- Purely chemical reaction in the food
- Action of micro-organisms e.g. bacteria, yeast and moulds
- Physical changes on the food

## PREPARATION OF FOOD FOR PRESERVATION

It must be emphasized that only wholesome foods should be preserved as preservation methods will not improve the quality of the food. We should therefore ensure that any food to be preserved must be of good quality. Also, to achieve the maximum effect of any preservation method employed, the food must be prepared accordingly.

Some of the preparation that should be embarked upon before preserving our foods are:

- Clean the food thoroughly
- Cut the food into desired sizes
- Ensure that the food is of good quality i.e. wholesomeness of the food
- Package food appropriately and label if need be

If the food is to be preserved in specific equipment e.g. the deep freezer or refrigerator, make sure that the equipment itself is very clean so as to avoid contaminations

### **FACTORS RESPONSIBLE FOR HIGH POST-HARVEST FOOD LOSSES IN WEST AFRICA COUNTRIES**

High post-harvest food losses, arising from limited food preservation capacity, are a major factor constraining food and nutrition security in developing countries of West Africa where seasonal food shortages and nutritional deficiency diseases are still a major concern. It is estimated that about 50% of perishable farm produce including fruits, vegetables, roots and tubers and about 30% of food grains including maize, millet, rice and so on are lost after harvest in West Africa. Ineffective or inappropriate food processing technologies, careless harvesting and inefficient post-harvest handling practices, bad roads, moribund rail systems, bad market practices and inadequate or complete lack of storage facilities, packing houses and market infrastructures are some of the factors responsible for high postharvest food losses in West Africa countries. The capacity to preserve food is directly related to the level of technological development and the slow progress in upgrading traditional food processing and preservation techniques in Nigeria, this contributes to food and nutrition insecurity. Traditional technologies of food processing and preservation date back thousands of years and unlike the electronic and other modern high technology industries, they long preceded any scientist understanding of their inherent nature and consequences. Traditional foods and traditional food processing and preservation technique form part of the culture of the people. Traditional food processing and preservation activities constitute a vital body of indigenous knowledge handed down from parent to child over several generations. Unfortunately, this vital body of indigenous knowledge is often undervalued. Regrettably, some of the traditional food products and food processing practices of people have undoubtedly been lost over the years. Indeed, simple low-cost, traditional food preservation techniques are the bedrock of small scale

### **VARIOUS METHODS OF PRESERVING FOOD**

People have various methods by which they preserve their food. These include: *drying, smoking, frying, salting, bagging, heating, fermentation, blanching etc.*

**DRYING /DEHYDRATION:** - drying is the process by which water is removed from farm products to a reasonable level to avoid spoilage. Drying is one of the oldest methods of food preservation.

### **TYPES OF DRYING**

1. Sundry or Solar drying e.g. cassava, maize, melon, cereal, legumes, yams etc.
2. Oven drying e.g. melon, legumes
3. Roller drying e.g. vegetable
4. Vacuum drying e.g. milk
5. Spray drying e.g. milk, egg white, cocoa beverages
6. Roasting on fire/hot oven e.g. meat, fish
7. Tunnel drying e.g. vegetable
8. Freeze drying e.g. vegetables, fish, meat

### **MERITS AND DEMERITS OF DRYING**

Drying reduces water activity sufficiently to prevent or delay bacterial growth. It works well for many food types. It is an inexpensive method of preservation as you rely more on the sun. Drying also reduces weight, making food more portable, dried foods are compact and easily stored or carried. Drying works because it removes much of the foods water, without adequate water, microorganisms cannot multiply and chemical activities greatly slow down. The greatest disadvantages of drying food include loss of colour, loss of flavour and loss of vitamins, some of these losses can be mitigated by not drying the food too long. Dried food can be kept for a long time without spoiling; examples of food that can be dried are maize, peeled cassava, peeled yam, some vegetables etc.

### **THE RATE OF DRYING OF FOODSTUFF CAN BE AFFECTED BY THE FOLLOWING FACTORS:**

- The amount of surface area of the foodstuff exposed to the dry air or heat
- The physical properties of the drying environment
- The efficiency of the equipment
- The method of arrangement of the food stuff on the drying material e.g. tray, mat, concrete floor in relation to the heat source or medium

**SMOKING:** - smoking is one of the ways of preserving farm produce. Smoking reduces water activity gradually to prevent bacteria and fungi growth. It works well for most food, like fish, tobacco leaves, etc., smoking works because it removes much of the foods water, it also reduces weight, making food more portable, dried foods are compact and easily stored or carried. The disadvantages of smoking food include loss of colour,

loss of aroma and loss of quality, some of these losses can be avoided by not smoking the food too long. Smoked food can be kept for a long time without spoiling. Farm animal produce like fish and meat are sometimes smoked with wood fish or coal fire. Smoking removes water from the fish or meat and impacts sensory qualities, reduce moisture content and extend shelf life.

**SALTING:** - Salting is another ancient method of preservation. Salt can be used as part of the drying process. Salt increases the storage time of some foods such as fish and it enhances the flavour of dried foodstuffs. The use of salt water brine is another common method of preservation and it has the benefit of stopping the growth of harmful organisms. Fish, meat and ground pepper can be preserved by either mixing or rubbing them with salt.

**FERMENTATION:** - fermentation is one of the oldest, traditional methods of food preservation. Food fermentation involves the use of microorganisms and enzymes for the production of foods with distinct quality attributes that are quite different from the original agricultural raw material. When a food ferments, it produces acids that prevent the growth of organisms that cause spoilage. The conversion of cassava to garri illustrates the importance of traditional fermentations. Apart from “garri” there is a vast array of traditional fermented foods produced in Nigeria. These include pap, condiments such as locust beans (iru), ogiri and alcoholic beverages such as shekete, agadagidi and kai-kai, palm wine. Lactic acid bacteria and yeasts are responsible for most of these fermentations. The fermentation processes for these products constitute a vast body of indigenous knowledge used for food preservation, acquired by observations and experience and passed on from generation to generation. Apart from detoxification by the elimination of naturally occurring nutritional stress factors, other benefits of traditional fermentation include reduction of mycotoxins such as aflatoxins as in pap processing and the conversion of otherwise inedible plant items such as African locust seed and bean to foods. I.e.

**Iru** (locust bean) and respectively by extensive hydrolysis of their indigestible components by microbial enzymes fermentation improves the flavour and texture of raw agricultural produce, imparting a desirable sour taste to many foods, such as garri and pap, and leading to the production of distinct flavour components characteristic of many fermented foods. Fermentation may lead to significant improvement in the nutritional quality of foods by increasing the digestibility of proteins through hydrolysis of proteins to amino acids increasing bioavailability of minerals such as calcium phosphorus, zinc and iron through hydrolysis of complexing agents such as phytate and oxalate, increasing nutrient levels, especially B-vitamins, through microbial synthesis. The locust bean’s name might seem deceiving – while only distantly related to beans, it is actually a tree. It is indigenous to the savannah regions of Africa, and most commonly found in the band stretching from Senegal to Uganda. The fruit pulp and seed extracts provide nutritious ingredients for traditional soups, sweetmeats and condiments across West Africa. The production and sale of dawadawa, the fermented extract of locust seeds, constitutes an important economic activity for women across West Africa.

The locust bean is also extremely hardy; it is well suited to a wide range of soils, it survives fires, thrives in semi-arid tropical climates, and has a low susceptibility to pests and diseases. The tree has a wide-reaching crown and can grow more than 20 meters tall. Often, people climb all the way to the top to pick the fruit – long pods, containing small seeds and a sweet edible pulp, that can grow as long as your forearm. The sugary pulp can be eaten raw, used in traditional sweetmeats or mixed with water to make a refreshing drink. Given its sweet taste, children love it, and because it keeps well for days, it is also popular among travelers.

While the pulp makes for a good energy snack, the seeds are the plant’s most sought after product. Rich in protein, starch, fiber, sugar, and fat, as well as vitamins and minerals, such as calcium and iron, the seeds are about as nutritionally balanced a food as you can find. Because the pods mature during “the hunger season,” when most other vegetation has dried, the locust bean is a true lifesaver – it can be a source of emergency food with a high nutritional value.

The seeds are famous for their greasy extract, which is fermented and pressed into cakes or balls, known in West Africa as dawadawa. It has a pungent odor, often compared to that of aged cheese, and is used as a condiment or an ingredient for soup. But the tree provides much more than just a source of nutritious food. Dawadawa’s widespread popularity makes the locust seed an important commercial item across West Africa. It is estimated that 200,000 tons of locust seeds are collected annually for dawadawa, just in northern Nigeria. The production and sale of dawadawa constitutes an important economic activity for women. In addition, the locust tree provides much-needed shade and shelter from desert winds in thousands of villages across the continent.

It is also beneficial to the underlying soil, which is improved by dung and urine of livestock that shelter under the tree’s shade. Its leaves are so rich in nitrogen and other minerals, that they are often collected as manure for soil improvement.

Most of the existing locust trees are found in the wild, and although the species’ response to horticulture remains unclear, its multiple benefits make it an ideal candidate to promote in other regions across the continent. The locust tree combines in a single species two of Africa’s greatest needs.

**ROASTING:** - Roasting is another method of preserving food, this impacts desirable sensory qualities, enhances palatability, reduce antinutritional factors. Peanuts are roasted by stirring in hot sand in a flat bottom frying pot over hot flame.

**BLANCHING:** - It is a method of preservation of food. It inactivates plant enzymes and minimize oxidative changes leading to deterioration in sensory and nutritional qualities e.g. Enzymatic browning e.g. Slices of yam for *elubo* (yam flour) production are heated in hot water in a pot for various durations.

**HANGING BASKET:** - Over the cooking area for preserving and drying food e.g. Fish is put inside the basket made of light or strings of iron and allowed to be dried by heat coming out of the cooking area or kitchen.

**CANNING OR BOTTLING:** - This process requires canning equipment and the ability to use a heat source. Foods preserved by this method are sealed in a closed container, such as a can, glass or bottle, such foods can be stored for up to a year. The cost of canning or bottling can be expensive after purchasing the equipment and use of heating fuel and it is a fiddly process requiring sterilization and knowledge of the temperature involved. Earning cannot be done in an oven but must be done using a water or steam bath. There is a risk of severe food poisoning if the process is not followed properly especially the case of low acid foods such as vegetables and meat. Lack of quality control in the canning process may allow ingress of water or micro-organisms. Most such failures are rapidly detected as decomposition within, it can cause gas production and it can will swell or burst. However, there have been examples of poor manufacture (underprocessing) and poor hygiene allowing contamination of canning food by the obligate anaerobe *Clostridium botulinum*, which produces an acute toxin within the food, leading to severe illness or death. This organism produces no gas or obvious taste and remains undetected by taste or smell. Its toxin is denatured by cooking.

**REFRIGERATION AND FREEZING:** - These methods are one of the most commonly used processes commercially and domestically for preserving a wide range of food including prepared food stuffs. Naturally, this requires access to electricity-generated refrigeration systems but if you have this it is one of the easiest methods to store food. There are many guidelines available on how long food can be stored in refrigeration or in a freezer.

Downsides to this method include loss of food due to not knowing what is in your freezer or lacking or lack of dating items when you freeze them thus necessitating throwing out items when you are not sure and a tendency to over stock refrigerators with food that goes off because nobody could consume it in time, or find it behind all the other food.

**IRRADIATION:** - Food irradiation is a physical method of preserving food. It has been thoroughly researched over the past decade and is recognized as a safe and wholesome method. It has the potential both of disinfecting dried food to storage losses and disinfecting fruits and vegetables to meet quarantine requirements for export trade. Low doses of irradiation inhibit spoilage losses due to sprouting of root and tuber crops. Food borne disease due to contamination by pathogenic micro-organisms and parasites of meat, poultry, fish are on the increase. Irradiation of these solid foods can decontaminate them of pathogenic organisms and thus provide safe food to the consumer.

One of the most important advantages of food irradiation processing or preservation is that it is a cold process which does not significantly alter physic-chemical characters of the treated product it can be applied to food after its final packaging one of the most important limitations of food irradiation preservation is its slow acceptance by consumers, due inter alia to a perceived association with radioactivity. The food industry tends to be reluctant to use the technology in view of uncertainties regarding consumer acceptance of treated foods. Considering its potential role in the reduction of post-harvest losses, providing safe supply of food and overcoming quarantine barriers, food irradiation has received wider government approvals during the last decade.

## Conclusion

One of the greatest challenges facing food scientists technologists in Nigeria today is the upgrading of the traditional methods of food preservation in most cases, the traditional methods of food preservation remain at the empirical level. They are still rather crude are not standardized and are not based on sound scientific principles making them in their present form unsuitable to large scale industrial production. The process is often laborious and time consuming and invariably the quality of products require substantial improvements in upgrading these technologies the food scientists is faced with the challenge of modernizing the processes and equipment while still retaining the traditional attributes of the food products crucial to consumer acceptance. While there have been some instances where the introduction of modern techniques has resulted in products unacceptable to consumers a number of successes have been recorded.

## Recommendations

The use of simple but effective on-farm and off-farm storage facilities and agro-processing technology should be promoted to add value to products and increase their shelf life. The Strategic Grain Reserve Scheme should be modernized, strengthened and upgraded to a National Food Reserve Program, which will enable it to handle all staples and essential food products. This will be the launch pad for the accelerated attainment of Nigeria's national food security goal. The Buffer Stock Food Storage Scheme of the states should incorporate the use of private storage facilities to maintain a national strategic stock of food that will be needed in times of national

food emergencies. It is also crucial to promote and develop agroprocessing in the country for the evolution of virile agro-allied industries and rural micro-enterprises.

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