

PROPER FISH HANDLING: A PREREQUISITE TO GET EXCELLENT PRODUCT

In African countries generally, fish are poorly handled, some die in the harvesting gear, while others get mixed up with sand and other contaminating debris at the landing shores.

In aquaculture, the method of harvesting which usually involves the dragging of sein nets on the bottom of a pond) contaminates the fish with mud and silt. The scales skin of some fish, like Clarias and Chrysichthys species can be badly bruised and damaged.

In addition to poor handling, the fish may pass through a long chain of distribution network before reaching the ultimate consumer. The simplified distribution chain for fish in most situations is:

Fisherman → wholesaler → Retailers → consumers

Fish must remain in acceptable quality to the end of this chain.

The high temperature and high relative humidity of the tropics greatly facilitates spoilage, resulting in a considerable loss of fish. To maintain good quality of fish from fisheries, good handling practices must involve keeping the fish cool, fish undamaged, fish flesh clean.

SPOILAGE INDICES

Bacterial are unicellular microscopic organisms which occur almost everywhere in nature. They are living things which often cause fish spoilage. They might have a generation time of 20 minutes at 30°C. In such a case a single bacterium may give rise to 4000 bacteria in 4 hours, 16 million in 8 hours and one billion in 10 hours, if temperature,

water content of the fish, osmotic pressure, pH medium, redox potential and the nutrient composition of the environment are conducive.

Bacteria Spoilage

Some bacteria are naturally present in the living fish but their multiplication and growth is limited by the general metabolic reactions of the fish (low pH of gut, anaerobic environment in the gut and its enzymes, acid in the viscera which often digest the bacteria and cause the gut condition to be unfavourable for their growth). When a fish dies, these metabolic actions are slowed down and micro-organisms begin to multiply. The bacteria living in the gills penetrate the flesh and the vascular system. Those lining the gut penetrate the nearby tissues through the peritoneum. Bacteria in the slime penetrate the skin into the environment tissues. The enzymes in the gut breakdown its lining and thus give way for bacteria to enter into the tissues. These bacteria secrete digestive juices and enzymes which breakdown the tissues and cause spoilage of the fish. The end result of microbial invasion of the tissues is the loss of fresh flavour and odour of the fish replacing it with a sour and stale odour which changes to Ammoniacal, putrid and faecal odour at the later stage of spoilage.

The initial elastic texture of the fish changes to softer flesh with grittiness making the fish exceedingly soft flabby retaining finger indentations in the skin. The flesh of such spoilt fish is later torn from the backbone (unfit for human consumption and must be discarded, down graded for the production of animal feed supplements (an economic loss, hence minimize fish spoilage through proper handling of fresh fish.

Enzymatic Spoilage

Enzymes are high molecular weight metabolic catalyst, protein in nature and are needed in small quantities. They operate in their native forms and become denatured when conditions become unfavourable. Temperature, acidity, substrate concentration and enzyme activation and synchronization affect enzyme activities

Enzymatic spoilage is known as AUTOLYSIS i.e. self digestion. It is a process whereby enzymes, against which the fish is normally protected alive, under optimal conditions for enzymatic activity, post mortem digest the fish tissue. Such enzymes are present in the fish gut, on the skin and in the tissues. Autolysis causes off-odour, off-flavour and softening of flesh and tissues. It causes general disruption and permeation of movement of enzymes and oxygen in the muscle. Such enzymes include Proteolytic and Cathepsins enzymes. They make the fish unpalatable, unattractive and unfit for consumption.

Cutting should be carefully and thoroughly done, and belly cavity should also be thoroughly washed.

Cathepsin is more active in fish than in meat resulting in faster autolysis in fish.

Chemical Spoilage

This is caused by the reaction of the fat of fish giving rise to unpleasant odour and flavour. This is called RANCIDITY which is as a result of highly unsaturated fatty acids in fish oil

ASSESSMENT OF FISH SPOILAGE

1. **Physical method**
2. **Instrumental test:** Placing a Torrymeter on the skin of about 16 randomly selected fish and picking 1 of the result as representative of the entire lot

3. **Subjective method:** involves the use of human sense organs and not machines, chemicals or reagents. It is often called sensory tests. This may be bias but it represents the customers view. Example of organoleptic test involves the utilization of sense of touch, smell, sight and taste for quality assessment of fish

Sight: gill colour, presence or absence of indentation.

Flavour: for degree of freshness, is also a combination of taste and odour caused by volatile organic compound. It is the most used objective test rather than taste panel evaluation even though too expensive (chromatograph which measure a flavour at a time). Thus they often train taste panel to prevent bias

Texture: state of the muscles, firmly held condition of the belly, presence of blemish and parasites on fish, visual examination in cured fish, general appearance, bulging cans, broken fishes.

Touch: texture of fish, elastic form, soft or flabby, fragmentation in dried whole fish, if fish end without breaking, it is flexible, **Brittle**--if it break into small

Smell--good and bad flavour, smoked or cooked (limited use because not all can smell)

Taste: sweet, bitter, salt and sour (salty or acid fermented and marinades-analytical method gives better results).

FISH PRESERVATION

Some of the fish preservation techniques have broadly grouped into two:

- Low temperature technique and,
- High temperature techniques

Low Temperature Techniques

This technique preserves fish by lowering their body temperature to a level that inactivates micro-organisms. It also reduce if not eliminate the activities of microbes. Low temperature techniques of preservation are also known as modern fish preservation methods and it includes:

- a. Chilling: chilling involve the use of ice-blocks or ice flakes, refrigerated sea water (RSW), or chilled sea water (CSW)
- b. Freezing: it is carried out using freezer e.g. blast freezing (using blast freezer), plate freezing, etc.
- c. Cold storage using cold room

Boxing

This involve laying fish on a 5cm thick ice at the bottom of a container (made of wood, metal, plastic, etc) followed by alternate layers of ice and fish with ice layered at the top of the uppermost layer of fish. Boxing has advantages over bulking and shelving in that fish could easily be separated into species, sizes or catches by using different boxes. Also removing fish boxes from fishing vessels are much less laborious than in bulking or shelving.

Bulking

This is laying fish on a bed of ice about 5cm thick and place alternate layers of ice and fish at a fish to ice ratio of one to one up to a total height of one meter. The demerits of bulking are that fish in bulk storage may suffer damage from pressure of the fish on top, including shrinkage and excessive loss in weight.

Shelving

This is a method whereby fish are laid out on shelves formed between the vertical partitions in the fish-hold. This method can be described as shallow bulking and where it is done correctly, it is a good method of storage. Fish can be stored by arranging fish orderly belly downwards and head to tail on ice 5cm thick on shelves with the fish completely surrounded by ice.

FREEZING

Freezing is one of the easiest and least time consuming methods of food preservation. Most food retains their natural colour, flavour and texture better than when other methods of food preservation are used. In addition, the kitchen remains cool and comfortable during the process.

High Temperature Techniques

This technique involves the use of heat i.e. raising the temperature of fish to a level not suitable for microbial multiplication and reducing the moisture content of the fish. This technique includes:

- a. **Drying:** this involves the use of solar radiation to increase the temperature of the fish and to reduce its moisture content. Example of solar fish drier include:
mud/bamboo solar drier, oil drum solar drier, solar dome drier, etc.

- b. Smoking: this involves the use of smoke from fire wood in smoking kilns to dried and preserve the fish. Example of smoking kiln include traditional Ghananians mud oven, NIOMR and Kaiinji gas smoking kiln, Chorkor fish smoking kiln, etc.
- c. Salting and Drying: applying salt to the body surface of fish and sun drying the fish.

DIFFERENCES BETWEEN HIGH TEMPERATURE TECHNIQUES AND LOW TEMPERATURE TECHNIQUES

High temperature	Low temperature
This constitute the traditional methods of fish preservation	This constitute the modern methods of fish preservation
It takes place even at the absence of electricity	May not take place except there is electricity or source of light
Can take place at the village, level at any where and at any time	May only be used in the towns and cities where there is source of power
Low cost	Expensive
Takes place under high ambient temperature	Takes place under low temperature (<4°C)
Labour intensive	Not laborious
Temperature may not often be controlled because there is no regulator	Temperature is often controlled (has regulator)
Time consuming	Time managing
Not often hygienic	Highly hygienic
Allow few quantity to processed at a time	Large quantity can be processed at a time
Needs little or no skill	Required skill in operation
Quality of products varies	Quality of product is uniform
Package is not often attractive	Package is very attractive
e.g. smoking, sun drying, and salting	e.g. freezing, chilling, icing and cold room

FISH SMOKING

Smoking as a method of preservation of perishable foods dates back to civilization. Fish and fishery products are one of the most perishable of all staple commodities. They are, therefore, suitable media for the growth and proliferation of micro-organisms. To prolong the shelf life of fish, fish is preserved by smoking. Smoke is generated from wood by burning. Smoke has bacteriostatic, bactericidal and antioxidant functions while heat generated from the wood has dehydrating effect on the fish.

The combination of these processes gives fish dry effect. Hence a well smoked fish can keep in storage for months without undergoing spoilage.

Fish smoking is the traditional occupation of artisanal fishermen and women in Nigeria with simple traditional ovens. There are different types of local ovens being used depending on the location. In the Northern part of the country, Banda is used generally while in the South, it ranges from simple pit-ovens to drum-oven. The most important advantage of these simple ovens is the low capital cost. However, many disadvantages have been reported which include:

- Inefficient utilization of fuel wood
- Poor quality of fish due to lack of control over the temperature of the fire and the density of smoke.

To arrest these problems many workers have invented improved smoking kilns such as Chorkor kiln, Altona/Watanabe smoking kiln, Ivory Coast kiln, etc.

TYPES OF FISH SMOKING PROCESS

Two types of smoking processes are in common use. The cold smoking process in which the temperature of the smoke does not exceed 30°C and hot smoking process during

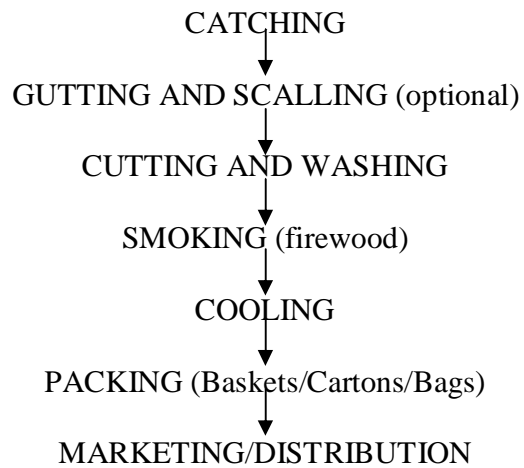
which the fish is properly cooked with their temperature reaching 120°C or so while the centre of the fish may be 60°C.

Cold smoking is practiced in advanced countries where alternative means of preserving the fish such as refrigeration is available. Cold smoking is primarily to improve the flavour of the fish and retain its nutritive value. Cold fish is not well cooked, has shorter shelf life and is easily infested by micro-organism such as bacteria and molds if not properly stored in a refrigerator. Moisture retention is usually high and may be in the order of 35-45%.

Hot smoking is the traditional method of fish smoking in the tropics. Fish is smoked until cooked in order to obtain a product with extended shelf-life, since alternative preservation methods such as refrigeration are absent in the remote fishing villages where most fish processing takes place. The primary aim of hot smoking is to preserve the product flavour and colour arising as a result of preservation function.

The Traditional Smoking Process

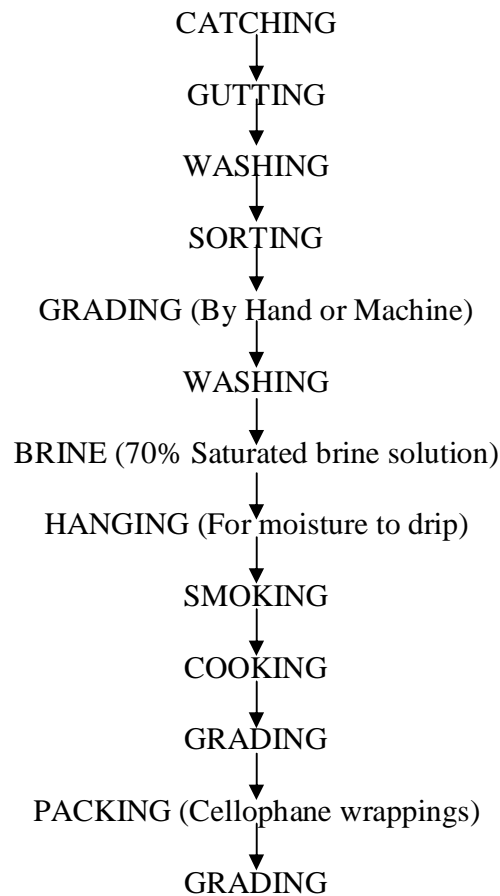
The traditional smoking process is widespread and supply the bulk of smoked fish found in most markets in Nigeria using the traditional smoking kilns. Below is the flow chart of how fish is smoked traditionally:



Flow-chart for a traditional Fish Smoking

The Modern Smoking Process

The modern smoking is practiced using the mechanical smoking kilns. This is mostly practiced in the advanced countries of the world. The smoking process can be summarized as follows:



Flow-chart of the Modern Smoking Process

FISH DRYING AND THE USE OF SOLAR TENT DRYERS

Drying of fish in the open sun is a common worldwide and also in Nigeria, especially in the arid and semi-arid regions such as Lake Chad area because of the very arid conditions there. However, there are significant losses due to spoilage, contamination by dust and insect infestation because the fishes are dried on bare ground.

To reduce post harvest losses and improve the poor conditions of fish dried on bare ground solar dryers of varied kinds and designs are in use in some part of the world for fish preservation.

Fishes dried in solar dryers like the solar tent are far cleaner and better than those on bare ground. They also have no foul smell arising from the fish as a result of on-set of decay.

NIFFR solar tent has been widely extended and accepted in over 20 fishing villages around Kainji Lake and Jebba Lake. The dryer is made of cheap and locally available material.

When many fisher folks around the country eventually adopt the technology, it is hoped that the solar dried fish (which bears very close resemblance to the imported cod stock) will save the country huge foreign exchange.

FISH PROCESSING

FISH CANNING

Is a process involving heat treatment of fish in sealed containers made of tin plates, aluminum cans or glass, until the product has been fully sterilized. For example canned Geisha and canned Sardines. It makes fish available for the inhabitants of very remote non-fishing areas.

During canning heat treatment should be sufficient to destroy all heat sensitive bacteria and spores, inactivate the enzymes and cook the fish so that the products remain acceptable to the consumers after prolonged storage.

Commercial Sterilization: it is used in thermal processing to describe the heat treatment designed to kill substantially all micro-organisms and spores which if present would be capable of growing in the product (it eliminate the spores of Clostridium botulism and reduced to the barest minimum the spores of the most heat resistance spore forming food spoilage micro-organism e.g. Bacillus stearothermophilus).

The canned food fish is also prevented from contamination by pathogenic organism by storing them in a air-tight package. If the heat treatment is properly carried out, canned fish may remain in storage for several years without refrigeration.

Excessive heat treatment or over processing must still be avoided, as this will adversely affect the organoleptic and nutritional quality of the fish.

Traditional canned fish are obtained from small pelagic fish species such as:

- Herrings (*Clupea spp*)
- Mackerel (*Scomberomerus spp*)
- Anchovies (*Engraulis spp*)
- Tuna (*Thunnus spp*)
- Bonga (*Ethmalosa spp*)

Morocco is the highest producer of canned Sardines.

Fish intended for canning must be in first class condition and must be handled in a hygienic manner to reduce the microbial load on the fish. Poor quality fish will produce canned fish with off odour and flavour with poor texture.

FISH MINCE

It can be defined as fish separated in comunitated form from the frames, scales, bones and fins of fish. Fish mince can be prepared either mechanically by the use of flesh/bone separator or non-mechanically. Fish mince is very versatile and can be used to make a variety of products such as fish portions, fish fingers, fish cakes, fish sausage and fish cheese.

Mechanical Preparation

The fish/bone (or meat/bone) separators also called deboning machines can be used to retrieve flesh attached to bones and frames of fish and thus makes them better utilized instead of discarding them as a waste. This machine consists of a feed belt, perforated drum, scraper and an auger.

Fish is prepared by removing the head, skin, bone, internal organs such as gut, kidney, liver, air-bladder, blood vessel, etc (i.e make fish blemish free material before passing to a flesh/bone separator).

The prepared fish is fed into the deboning machine which squeezed the fish between the feed belt and perforated drums in such a way as to allow only flesh to pass through. While the bones and skins are collected separately. This is used in recovering so-called flesh (about 10% extract flesh) which otherwise would have been discarded from its frame. All these are utilized, thus maximizing the profit from the landings and fish is still made available cheaply to the consumers.

Non-mechanical

It involves the use of organic acid to produce minced fish by a combination of physical and chemical methods, and end product may have rancidity or autolysis.

SURIMI

These are wet concentrates of proteins of fish muscle that is mechanically de-boned, water-washed fish flesh. It is prepared from marine fish after minced fish has been cold water-washed at 10% to remove fat and water soluble components. After washing, sieve the water to recover the remaining solids which is tasteless, odourless and white which is the base for surimi. The end product is frozen and is used in the preparation of diverse

fish foods such as kamaboko, tempura and chikwa (Japanese Surimi based products), fish sausage, fish ham, fish stick, fish balls and hamburger.

The difference between minced fish and Surimi is that while minced fish is the fish flesh which is separated from bones and skin (usually mechanically) surimi is prepared after minced fish have been washed in water to removed fat and wet soluble components.

Differences between fish processing and preservation

- Processed fish may be consumed directly while preserved fish may need some form of preparation before consumed
- Processing of fish often enhance its quality while fish preservation does not
- Fish processing is laborious and time consuming while fish preservation requires short time and not laborious
- Fish processing is quite expensive while fish preservation is less expensive
- Fish preservation require high technical know-how and skill labour while fish preservation require little or no skill

Similarities between fish processing and preservation

- ✚ Both increase shelf-life of fish
- ✚ Both can occur simultaneously. For example fish meal produced by sun-drying, oven drying or smoking (preservation) before grinding (processing)
- ✚ They both reduce post harvest resource waste/loss
- ✚ Both produce end point which are different from the starting point

Note: chorkor etc, spoilage at the beginning



<http://www.aquariumfish.net/pages/videos.htm>