PROCESSING AND PRESERVATION OF FISH IN REFERENCE OF SALTING, SMOKING AND DRYING

BY

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CERTIFICATION

This research work has been read and approved as meeting the requirement for the award of National Diploma (ND) in Hospitality Management, Institute of Applied Science Studies, Kwara State Polytechnic, Ilorin, Kwara State.

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DEDICATION

This research work specially and firstly dedicated to Almighty God, for he is merciful and kind.I give him all the praise and gratitude for all inspiration, wisdom, knowledge and understanding who up right by me from the inception till the end of my programme.

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All praise being only to the supreme being, God of all creations. The beginning and the end of everything

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Am using this medium to appreciate the effort of my lovely parent Mr

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ABSTRACT

Fish is one of the protein foods that needs careful handling. This is because fish spoils easily after capture due to the high tropical temperature which accelerates the activities of bacteria, enymes and chemical oxidation of fat in the fish. Immediately after fish died, the autolysis will take and later digestive juices will invade the flesh and start putrefaction. Then fat is attacked by oxygen and gives rancidity, especially in smoked and dried fish, Sweety flavour in fish, due to inorganic acid, when broken down during autolysis, produce bitter flavour and hypoxanthine formation. Later micro-organisms in the gut and at the surface of skin will multiply rapidly and will pick up more during handling, transportation and processing, accelerating the chemical changes in texture, taste, appearances and qualities. Fish must be preserved by storing it in time of abundance for use in time of shortage. Therefore all methods or any technical method may be resorted to keep the products; (a) free of pathogenic and spoilage micro-organisms and their toxins, (b) free of chemical compounds causing problems, (c) nutritional quality is retained and (d) extending the shelf-life of fish and fishery products by icing and chilling, drying, smoking, salting, boiling and steaming, freezing, using chemical reagent and additives, packaging and radiation. Processing is a function besides, handling, transport and storage involved in the products flow from the production sectors to the consumption sectors. Fish products, as commodities can be divided into primary or basic fish products (in the round from or dressed with minimium processing), low-cost minimum storage products and convenienc products.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Fish is one of the protein foods that needs careful handling (Eyo, 2004). This is because fish spoil easily after capture due to the high tropical temperature which accelerates the activities of bacteria, enzymes and chemical oxidation of fat in the fish. Due to poor handling, about 30-50% of fish harvested are wasted in Nigeria. These looses could be minimized by the application of proper handling, processing and preservation techniques (Bate and Bendall, 2010).

The purpose of processing and preserving fish is to get fish to an ultimate consumer in good, unstable condition. The step necessary to accomplish this begin before the fishing expenditure starts, and do not end until the fish in eaten or processed into oil, meal, or a feed (Karube et al., 2001). Fish begin to spoil as soon as it is caught, perhaps even before it is taken out of the water. Therefore, the key to delivering a high quality product is close attention to small detail throughout the entire process of preparation, catching, landing, handling, storage, and transport. Fish that becomes spoiled or putrid is obviously unusable (Gopakumar, 2000). fish that is poorly cared for may not be so obviously bad, but it loses value because of off-flavors, mushy texture, or bad color that discourage (Burt, 2003), a potential purchaser

form buying. If customers have bought one bad fish, they probably won't buy another. On the other hand, if you consistently deliver good quality at a fair price, people will become loyal customers (Nelson et al., 2004).

Spoilage proceeds as a series of complex enzymatic bacterial and chemical changes that begin when the fish is netted or hooked (Burt, 2003). this process begin as soon as the fish dies. The rate of spoilage is accelerated in warm climates. The fish's gut is a rich source of enzymes that allow the living fish to digest its food (Lima Dos Santos et al., 2011). Once the fish is dead, these enzymes begin digesting it too. This is why the fish becomes soft and the smell of the fish becomes more noticeable.

There are countless bacteria naturally present on the skin of the fish, in the gills, and in the intestines (Karube et al., 2001). Normally, these bacteria are not harmful to a living fish. Shortly after death, however, they begin to multiply, and after two to four days they ingest the flesh of even a well- iced fish as enzymatic digestion begins to soften it. The bacterial load carried by a fish, from clean water, will keep better than fish dragged along the bottom of a dirty pond in a trawl net. Both enzymatic digestion and bacterial decomposition involve chemical changes that cause the familiar odors of spoilage (Putro, 2005). Oxygen also react chemically with oil to cause rancid odors and taste. The aim of fish processing and preservation is to slow down or prevent this enzymatic, bacterial, and chemical deterioration and to

maintain the fish flesh in a condition as near as possible to that of fresh fish (bate and Bendall, 2010).

FRESH fish rapidly deteriorate onless some way can be found to presearve it. Drying is a of food preservation that work by removing, water from the food, which inhabits the growth of microorganism. Open air drying using sun and wind has been practiced since ancient times to preserve food. Water is usually remove by evaporation (air drying, sun drying, smoking, or wind drying) but in the case of freeze-drying, food is first frozen and then the water is removed by sublimation bacteria, yeast and molds need the water in the food to grow and drying effectively prevent them from surviving in the food.

Fish are preserve through such traditional method as drying smoking and salting. The oldest traditional way of preserving fish was to let the wind and sun dries it (Wikipedia, 2016) drying food is the world oldest known preservation method and dried fish has to storage life of several years. The method is cheap and effective in suitable climate, the work can be done by the fisherman and family and the resulting product is easily transported to market (Wkipedia,2016).

Any kind of fish can be smooked or dried. There are three main method of smoking, smoking and roasting, Hot smoking and long smoking.

Smoking and roasting is a simple method of preservation for consumption either directly after curing or within twelve hours. Re-smoking and roasting can keep the product in good condition for a further twelve hours fresh unsalted fish is put over a wood or coconut hust fire (Adedeji and Adetuji 2004, Adetuji, 2012)

The hot smoking system can be used for immediate consumption or to keep the fish for a maximum of 48 hours. Small fish can be salted first for half an hour (see wet salting). after salting they are put on iron spits and dried in a windy place or in the sun for another half hour. It is necessary to have an oil drum to make the smoking stove. (Adedeji and Adetuji 2004, Adetunji, 2012)

Long Smoking: If fish must be kept in good condition for a long time, for instance, two or three months or even longer, it can be done by smoking, provided the fish is not oily. For this purpose, a small closed shed made of palm leave or other local material can be used. (Adedeji and Adetuji 2004, Adetunji, 2012)

1.2 STATEMENT OF THE PROBLEM

This study is considering the two type of dries fish in Nigeria which are stock fish and clip fish.

STOCK FISH is unsalted fish, especially cod, dried is the most common fish used in stock fish product though other whitefish, such as padlock, hadlock,

ling and tusk are also used. Over the centuries several variants of dried fish has evolved. Stock fish, dried as fresh fish and not salted, is often confused with clip fish, where the fish is salted before drying. After 2-3 week in salt the fish has salt was earlier dried on rocks (slips) on the foreshore. Stock fish is cured in a process called fermentation where cold adapted bacteria mature the fish. Similar to the maturing process of cheese. Clip fish is processed in a chemically curing process called salt maturing. Similar to the maturing processed of other salt mayured product like the parma ham.

1.3 OBJECTIVE OF THE STUDY

The following are the objective of this study.

1. To provide an overview of fish drying
2. To understand the benefit of fish drying
3. To determine the effect of fish drying and its nutritional value to human

1.4 RESEARCH QUESTION

1. What is the processes of fish drying?
2. What are the benefit of fish drying?
3. What is the effect of fish drying and it nutritional values to human?

1.5 SIGNIFICANCE OF THE STUDY

The following are the significance of this study.

1. Outcome of this study will educate on the process and the benefit of fish drying in Nigeria. This study will also reveal the effect of fish drying on the nutritional values of fish.

2. This research will be a contribution to the body of literature in the area of the effect of personality trait on student's academic performance, thereby research in the subject in the subject area.

1.6 SCOPE OF THE STUDY

This scope will cover the process and the benefit of fish in drying in Nigeria. It will also cover the nutritional value of the dried fish.

1.7 LIMITATION OF STUDY

FINANCIAL CONSTRAINT: Insufficient funds tend to impede the efficiency of the researcher in sourcing for the relevant materials literature or information and in the process of data collection (internet questionnaire and interview).

TIME CONSTRAINT: The researcher will simultaneously engage in the study with other academic worth. This consequently will cut down on the time devoted form the research work.

1.9 DEFINITION OF TERMS

Preservation Of Fish: is the method of increasing the shelf life of fish and other fish products by applying the principles of different branches of science in order to keep the fish, after it has landed, in a condition wholesome and fit for human consumption.

Fish: This is an aquatic, craniate, gill - bearing animals that lack limbs with digits.

Salting: Salting is a traditional method of fish processing in many countries of the world. It can be used in combination with drying or smoking.

Smoking: Fish that has been cured by smoking. Food have been smoked by humans throughout history. Originally this was done as a preservative.

Sun Drying: This process is carried out by exposing target fish directly under the sun.

CHAPTER TWO

LITERATURE REVIEW

2.1 FISH

A fish is any member of a group of animals that consist of all gillbearing aquatic craniate animals that lack limbs with digits (Flajnik and Kasahara, 2009). Included in this definition are the living hagfish, lampreys, and cartilaginous and bony fish as well as various extinct related groups (Helfman et al., 2004). Tetra-ponds emerged within lobe-finned fishes, so sadistically they are fish as well. However, traditionally fish are rendered obsolete or paraphyletic by excluding the tetrapods (i.e., the amphibians, reptiles, birds and mammals which all descended from within the same ancestry) (Helfman et al., 2004). Because in this manner the term "Fish is defined negatively as a paraphyletic group, it is not considered a formal taxonomic grouping in systematic biology. The traditional term pisces (also ichthyes) is considered a typological, but nota phylogenetic classification (Nelson and Joseph, 2006).

The earliest organisms that can be classified as fish were soft-bodied chordates that first appeared during the Cambrian period. Although they lack a true spine, they possessed notochords which allowed them to be more agile than their invertebrate counter parts. Fish would continue to evolve through the Paleozoic era, diversifying into a wide variety of forms (Johnson, 2005). Many fish of the Paleozoic development external armor that protected them from predators. The first fish with jaws appeared in the Silurian period, after which many (such as sharks) became formidable marine predators rather than just the prey of arthropods (Nelson, 2006).

Most fish are ectothermic ("Cold -blooded"), allowing their body temperatures to vary as ambient temperature change, though some of the large

active swimmers like white shark and tuna can hold a higher core temperature (Goldman, 2011;). Fish are abundant in most bodies of water. They can be found in nearly all aquatic environments, from high mountain streams (e.g. char and gudgeon) to the abyssal and even hadal depths of the deepest oceans (e.g. gulpers and angler fish). With 33,100 described species, fish exhibit greater species diversity than any other group of vertebrate (Lecointre, 2007).

2.1.1 TAXONOMY

Fish are a paraphyletic group: that is, any clade containing all fish also contains the tetrapods, which are not fish. For this reason, groups such as the "Class Pisces" seen in older reference works are no longer used in formal classifictions.

Traditional classification divide fish into three extant classes, and with extinct forms sometimes classified within the tree, sometimes as their own classes: (Romer and Parsons, 2011; Benton, 2005)

- ❖ Class Agnatha (Jawless Fish)

Subclass Cyclostomata (Hag fish and lampreys)

Subclsass Ostracodermi (armoured jawless fish)

- ❖ Class Chondrichthyes (cartilaginous fish)

Subclass Elasmobrachii (shark and rays)

Subclass Holocephali (chimaeras and extinct relatives)

- ❖ Class Placodermi (armoured fish)

Class Acnthodii ("spiny sharks", sometime classified under bony fishes)

2.1.2 FRESHNESS OF FISH

Freshness is usually judged in the trade entirely by appearance, odour and texture of the raw fish (Karube et al., 2001). Since assessment depends upon the senses, these factors are known as sensory or organoleptic. The most important things to look for the freshness of fish are:

1. The general appearance of the fish including that of the eyes, gills, surface slime and scales and the firmness or softness of the flesh.

2. The odour of the gills and belly cavity;

3. The appearance, particularly the presence and absence of discoloration along the underside, of the backbone.

4. The presence or absence of rigor mortis or death stiffening.

5. The appearance of the belly walls (Bate and Bendall, 2010)

2.2 CAUSES OF SPOILAGE OF FISHES

Spoilage and freshness are the two qualities that have to be clearly defined (Gram and Huss, 2000). A fresh product is defined as the one whose original characters remain unchanged. Spoilage therefore is the indicative of post-harvest change (Hui, 2006). This change may be graded as the change from absolute freshness to limits of acceptability to unacceptability. Spoilage is usually accompanied by change in physical characteristics. Change in colour, odour, texture, colour of eyes, color of gills and softness of the muscle are some of the characteristics observed in spoiled fish (Baird-Parker, 2000). Spoilage is caused by the action of enzymes, bacteria and chemicals present in the fish. In addition, the following factors contribute to spoilage of fish (Abbas and Saleh, 2009).

- High moisture content
- High fat content

- High protein content
- Weak muscle tissue
- Ambient temperature
- Unhygienic handling

2.2.1 PROCESS OF SPOILAGE

Fish is highly nutritive. It is tasty because of its constituents. The main components of fish are water, protein and fat (Adebowale et al., 2008). The spoilage of fish is a complicated process brought about by actions of enzymes, bacteria and chemical constituent. The spoilage process starts immediately after the death of fish. The process involves three stages (Amos, 2007).

1. Rigor mortis

2. Autolysis

3. Bacterial invasion and putrefaction

2.2.2 TYPES FISH SPOILAGE

2.2.2.1 ENZYMATIC SPOILAGE

Shortly after capture, chemical and biological changes take place in dead fish due to enzymatic breakdown of major fish molecules (FAO, 2005). Hansen et al. (2003) stated that autolytic enzymes reduced textural quality during early stages of deterioration but not produce the characteristic spoilage off-orders and off flavors. This indicates that autolytic degradation can limit shelf-life and product quality even with relatively low levels of spoilage organisms (FAO, 2005). Most of the impact is on textural quality along with the production of hypoxanthine and formaldehyde. The digestive enzymes cause extensive autolysis which rsults in meat softening, rupture of the belly

wall and drain out of the blood water which contains both protein and oil (FAO, 2005).

A number of proteolytic enzymes are found in muscle and viscera of the fish after catch. These enzymes contribute to post mortem degradation in fish muscle and fish products during storage and processing. There is a sensorial or product associated alteration that can be contributed by proteolytic enzymes (Engvang and Nielsen,2001). During improper storage of whole fish, proteolysis is responsible for degradation of proteins and is followed by a process of solubilization (Lin and Park, 2006). On the other hand, peptides and free amino acid can be produced as a result of autolysis of fish muscle proteins, which lead toward the spoilage of fish meat as an outcome of microbial growth and production of biogenic amines (Fraser and Sumer, 2008). Belly bursting is caused by leakage of proteolytic enzymes from pyloric caeca and intestine to the ventral muscle. The proteases have optimal pH in the alkaline to neutral range. Martinez and Gildberg (2011) reported that the rate of degradation by proteolytic enzymes was reduced when the fish was kept at $0^{o}C$ and a pH of 5.

2.2.2.2 MICROBIAL SPOILAGE

Composition of the microflora on newly caught fish depends on the microbial contents of the water in which the fish live. Fish mictoflora include bacterial species such as Pseudomonas, Alcaligenes, Vibrio, Serratia and Micrococcus (Gram and Huss, 2000) Microbial growth and metabolism is a major cause of fish spoilage which produce amines, biogenic amines such as putrescine, histamine and cadaverine, organic acids, sulphides, alcohols, aldehydes and ketones with unpleasant and unacceptable off-flavors (Dalgaard et al., 2006; Emborg et al., 2005;Gram and Dalgard, 2002). For unpreserved fish, spoilage is a result of Gramnegative, fermentative bacteria

(such as Vibrionaceae), whereas psychrotolearnt Gram-negative bacteria (such as Pseudomonas spp. and Shewanela spp.) tend to spoil chilled fish (Gram and Huss, 2000). It is, therefore, important to distinguish non spoilage microflora form spoilage bacteria as many of the bacteria present do not acually contribute to spoilage (Huss, 2005) Trimethylamine (TMA) level are used universally to determine microbial deterioration leading to fish spoilage. Fish use Trimethylamine Oxide (TMAO) as an osmo-regulant to avoid dehydration in marine environments and tissue waterlogging in fresh water.

Bacteria such as Shewanellaputrifaciens, Aeromonas spp., psychrotolerant Enterobacteriacceae, P. phosphoreum and Vibrio spp. can obtain energy by reducing TMAO to TMA creating the ammonia-like off flavors (Gram and Dalgaard, 2002). Pseudomonas putrifaciens, fluorescent pseudomonads and other spoilage bacteria increase rapidly during the initial stage of spoilage, producing many proteolytic and hydrolytic enzymes (Shewan, 2001).

2.2.2.3 CHEMICAL SPOILAGE

Lipid oxidation is a major cause of deterioration and spoilage for the pelagic fish species such as mackerel and herring with high oil/fat content stored fat in their flesh (Fraser and Sumar, 2008). Lipid oxidation involves a three stage free radical mechanism: initiation, propagation and termination (Frankel,2005;Khayat and Schwall, 2003). Initiation involves the formation of lipid free radicals through catalysts such as heat, metal ions and irradiation. These free radicals which react with oxygen to form peroxyl radicals.

During propagation, the peroxyl radicals reacting with other lipid molecules to form hydroperoxides and a new free radical (Fraser and Sumar, 2008; Hultin,2004). Termination occurs when a build up of these free radicals interact to form non radical products. Oxidation typically involves the

reaction of oxygen with the double bonds of fatty acids. Therefore, fish lipids which consist of polyunsaturated fatty acids are highly susceptible to oxidation. Molecular oxygen needs to be activated in order to allow oxidation to occur. Transition metals are primary activators of molecular oxygen (Hultin, 2004). If fish, lipid oxidation can occur enzymatically or nonenzymatically. The enzymatic hydrolysis of fats by lipases is termed lipolysis (fat deterioration). During this process, lipases split the glycerides forming free fatty acids which are responsible for: (a) common off flavour, frequently referred to as rancidity and (b) reducing the oil quality (Huisin't Veld, 2006; FAO, 2005). The lipolytic enzymes could either be endogenous of the food product (such as milk) or derived from psychrotrophic microorganism (Huisin't Veld, 2006). The enzymes involved are the lipases present in the skin, blood and tissue. The main enzymes in fish lipid hydrolysis are triacyl lipase, phospholipase A2 and phospholipase B (Audley et al., 2008; Yorkowski and Brockerhoft,2005).

Non-enzymatic oxidation is caused by hematin compounds (hemoglobin, myoglobin and cytochrome) catalysis producing hydroperoxides (Fraser and Sumer, 2008). The fatty acids fromed during hydrolysis of fish lipids interact with sarcoplasmic and myofibrillar proteins causing denaturation (Anderson and Ravesi, 2009; King et al., 1962). Underland et al. (2005) reported that lipid oxidation can occur in fish muscle due to the highly pro-oxidation Hemoglobin (Hb), specifically if it is deoxygenated and/or oxidized.

PRESERVATION FOR LONG DURATION

SALTING

There are many different kinds of salt, some being better than others for fish curing. However, in island or in outlying place there is often no choice,

and whatever is available in the way of salt has to be used, whether it is bought in a shop, prepared on the spot, or extracted from earth containing salt. A distinction must be made between the two chief techniques of salting: wet salting and dry salting (FAO,2005)

WET SALTING

The principle is to keep the fish for a long time in brine. The equipment needed consists of a watertight container, which can be a tin, drum, canoe, barrel, etc. To make the brine, one takes four parts of clean water (sea or fresh water) and one part of salt. If the salt is coarse, it has to be ground or pounded first (Tys and Peters, 2009). It is then dissolved into the water by stirring with a piece of wood. To be good, the brine must float a fish. The next step depends on what kind of fish one want to salt. It is best first to cut off the head, and gut and clean the fish, though small fish can also be salted whole. Large fish must be cut open, and it is preferable to take out the backbone. Fish with a heavy armour of scales must be scaled. Inplaces where the flesh is thick, slashes must be made so that the salted brine can penetrate the flesh. Very large fish should be cut in thin fillets. After the fish has been prepared according to its size, it must be cleaned and put in the brine (FAO, 2008). A plank or matting is laid over it and weighted with rocks so that the fish is entirely covered with brain. This salted fish can be kept for a long time in a dark or at least a shady place (Leistner and Gould, 2002).

The remaining brine can be used three times, but water and salt must be added every time until a fish can again float on the liquid. In any case, fresh brine is always best.

DRYING SALTING

In this method, the fish is salted but the juices, slime and brine are allowed to flow away. Drying salting can be in an old canoe, or on mats

leaves, boxes, etc. In any case, the brine formed by the fish juices and the salt must be allowed to run away. For two parts of fish, one needs one part of salt (Kauffeld et al., 2005). Layers of fish must be separated by layers of salt. It is a valueable method when one has no containers. This method is used to salt down flying fish in open fishing boats while at sea, and the fish in this case are kept whole. Some people like the salty taste of fish prepared in this way, but it is always possible to wash the salt away by soaking it in fresh water before use (FAO, 2005).

DRYING

Very small and thin fish can be dried straight away in the sun if they are brought in early enough in the morning (and if, of course, the sun is shining). if these conditions are not fulfilled the fish must be put for one night in brine, or dry salted. They can then be dried the next morning (Deepchill, 2010). if it happens to be raining the next day, it is necessary to wait until the weathers has cleared up, which could take from a few hours to a wait couple of days. In the latter case it will be necessary to wash the salt away from the fish by soaking it in fresh or sea water for a couple of hours before drying it; this depends again on the taste of the consumers and on the purpose for which the fish is cured (Huss, 2009).

Small fish are mostly sun dried on mats, or suspended. When it rains the fish must be kept dry by covering or transferring them under shelter. If fish are laid on mats or other material to dry, it is best to turn them over every two hours so that they will dry quickly and not becomes maggotty. In the case of large fish, hanging is better if they are merely split (Ananou et al., 2007).

Salted fish can also be dried, but they should first be clean in water. Normally the fish will be dried after three days. If a great quantity of fish has been dried and is to be kept for some time, the best way is to pile it up in a

dark place, off the ground and preferably on wooden boards. It should then be covered with a snack or mat. After a fortnight the fish should again be laid in the sun for one or two hours and then put away as before. These are only indication of the main principle of fish drying; variations are possible (Leister and Gould, 2002).

SMOKING

Any kind of fish can be smoked. There are three main methods of smoking:

a) Smoking and roasting

b) Hot smoking

c) Long smoking.

Smoking and Roasting: This is simple method of preservation, for consumption either directly after curing or within twelve hours. Re-smoking and roasting can keep the product in good condition for a further twelve hours (Kauffeld et al., 2005). Fresh unslated fish is put over a wood or coconut husk fire. This should be kept very small and the fish turned over every five minutes. In about half an hour the fish is ready for consumption or, if is the intention to keep it for a while, it should be put in an aerated container (Tys and Pieters, 2009).

Fish can be preserved in this way even in open fishing boats, but the smoking has to be done in a tin or a half-drum. Salted fish can also be smoked by this method, but this is used mostly for immediate consumption or in order to bring the produce in smoked form to a nearby market.

Hot Smoking: The hot smoking system can be used for immediate consumption or to keep the fish for a maximum of 48 hours. Small fish can be salted first for half an hour (see wet salting). After salting they are put on iron

spits and dried in a windy place or in the sun for another half hour. It is necessary to have an oil drum to make the smoking stove. The top of the drum is cut out and holes are made 8 inches below the rim to place spits. Near the bottom a rectangular opening is made to control the fire. This opening should be closed with a small door or piece of steel plate. A fire of hardwood or coconut husks is made in the stove, and once it is well started it is regulated so as to give no flames (Tys and Pieters, 2009). The fish are the then placed over the spits. During the smoking operations the top of the drum must be covered with a sack or with palm fronds laid as close together as possible; the fire control opening should also be closed. The fire must be watched from time to time. The fish will be ready in about one hour. An indication that they are done will be found in the golden yellow colur of the skin. For big fish, 1 i to 2feet long, the best method is to splits them in halves, to the right and left of the backbone. Each half fish is fixed between two flat bamboo slats or sticks. These halves are then rested head down on racks built four feet above ground. A number of split fish can be lined up next to each other.

A fire of hardwood or coconut husks, or several separate fires, are then lit under the rack. The number of fires depends on the quality of fish one has to smoke. There should be a slow fire for about half an hour followed by a brisk one for one hour. A small fire is then kept going for six hours (just smoking) (Alasalvar et al., 2011).

After this treatment the fish is ready for transport and will keep in good condition for two to three days under tropical conditions. This method is used in particular in the Celebes for skipjack and other tunas (Ananou et al., 2007),

FISH CANNING

This 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 (Idachaba, 2001). During caning, heat treatment should be sufficient to destroy all heat sensitive bacterial and spores, in activate, the enzymes and cook the fish so that the product remains acceptable to the consumer after prolonged storage i.e (FAO, 2005) commercialized sterilization this is used in thermal processing to describe the heat treatment designed to kill substanially all microorganisms and spores which is present and cable of growing in the product (FAO, 2008). The canned food fish is also prevented from contamination by pathogenic organisms by storing them in a virtually airtight package. If heat treatment is properly carried out canned fish may remain in storage for several years without refrigeration (Leistner and Gould, 2002). Traditional canned fish are obtained form small pelagic fish species such as herrings (Clupeaspp), Sardines (Sardinellasp), Mackerels (Scomberomerussp), Anchovies (Engratulispp), Tuna (Thunnussp), Bonga (Ethmalosasp) (Gopakumar, 2010). Fish intended for canning must be in first class condition and must be handle in hygienic manner to reduce microbial load on the fish. Poor quality fish will produce canned fish with offensive odour and flavour, poor texture (Burt, 2003).

DEMERITS OF FISH PRESERVATION

Although the preservation and processing constitute a very important aspect of the fish industry, it has certain draw backs; (Bate and Bendall, 2010).

1. Chilling brings about denaturation of flesh. This is because of ice crystals formed during chilling and causing mechanical damage to the muscles. Cells wall burst, structure gets deformed and the flesh loses much of flavour and taste. The flesh also becomes dehydrated and losses texture (FAO,2008).

2. If proper hygienic measures are not taken during the processes like washing, guttation and evisceration, etc. more harm would be done to the preserved material, owing to increase in the bacteria population.

3. Incomplete or poor preservation leads to decarboxylation of histidine of fish flesh into histamine. The latter some other related substances, collectively called saurine, are common causes of food poisoning (Karube et al., 2001).

4. Drying reduces weight, nutritive value and the digestibility of the flesh.

5. Excess salting allows growths of salt tolerant bacteria, causing pink eye spoilage of fish flesh.

6. Salting combined with smoking result in loss of protein, about 1 to 5% due to salting and 8-30% due to smoking.

7. Smoking also accelerates rancidity of fat and so reduces digestibility of fat products.

8. Canning leads to much loss of vitamin B1, panthotenic acid, vitamin C and pteroxylglutamic acid (FAO,2005).

CHAPTER THREE

RESEARCH MOTHODOLOGY

3.1 INTRODUCTION

This chapter covers the description and discussion on the various techniques and procedures used in the study to collect and analyze the data as it is deemed appropriate.

3.2 RESEARCH DESIGN

For this study, the survey research design was adopted. The choice of the design was informed by the objectives of the study outlined in chapter one. This research design provides a quickly efficient and accurate means of assessing information about a population of interest. It intends to study the effect of strategic communication and public relations in management of hotels. The study will be conducted in Ilorin metropolis.

3.3 STUDY AREA

This research work centres on the production and preservation of fish in references of salting, smoking and sun drying.

The choice of this type of nut was informed by the fact that our local nut which are on popular needed to be brought out to the national level and also on the international standard.

3.4 POPULATION OF THE STUDY

The population for this study were residents in Ilorin metropolis, Kwara State, Nigeria. A total of 134 respondents were selected from the population figure out of which the sample size was determined. The reason for choosing Ilorin metropolis is because of its proximity to the researcher.

3.5 SAMPLE AND SAMPLING TECHNIQUES

The researcher used Taro Yamane's formula to determine the sample size from the population. Taro Yamane's is given as:

$$n = \frac{N}{1+N(e)^2}$$

Whereby N= Population of study (134)

n = Sample size(?)

e= Level of significance at 5% (0.05)

1 = Constant

$$n = \frac{134}{1+134(0.05)^2} \qquad \frac{134}{1- 134\ (00025)} \qquad \frac{134}{1+0.335}$$

$$n = \frac{134}{1.335} = 30$$

The sample therefore is 30 respondents.

3.5 RESEARCH INSTRUMENT AND INSTRUMENTATION

Data for this study was collected form primary and secondary sources. The primary source of data collected was mainly the use of a structured questionnaire which was designed to elicit information on the effect of strategic communication and public relations in management of hotels. The secondary source of data collections were textbooks, journals and scholarly materials.

3.6 VALIDITY OF INSTRUMENT

The instrument of this study was subjected to face validation. Face validation test the appropriateness of the questionnaire items. This is because

face validation is often used to indicate whether an instrument on the validation, copied of the initial draft of the questionnaire will be validated by supervisor. The supervisor is expected to critically examine the items of the instrument with specific objectives of the study and make useful suggestion to improve the quality of the instrument. Based on his recommendations the instrument will be adjusted and re-adjusted before being administered for the study.

3.7 RELIABILITY OF INSTRUMENT

The coefficient of 0.81 was considered a reliability because according to Etuk (1990), a test retest coefficient of 0.05 will be enough to justify the use of a research instrument.

3.8 METHOD OF DATA COLLECTION

This study is based on the two possible source of data, which are the primary and secondary source.

a. **Primary Source of Data:** The primary data for this study consist of raw data generated from responses to questionnaries and interview by the respondents.

b. **Secondary Source of Data:** The secondary data includes information obtained through the review of literature that is journals, monographs, textbooks and other periodicals.

3.9 METHOD OF DATA ANALYSIS

Data collected will be analyzed using frequency table, percentage and mean score analysis while the non parametric statistical test (hi - square) was used to test the formulated hypothesis using SPSS (statistical package for social sciences). Haven gathered the data through the administration of

questionnaire, the collected data will be coded, tabulated and analyzed using SPSS statistical software according to the research question and hypothesis. In order to effectively analyze the data, collected for easy management and accuracy, the chi square method will be used for test of independence. Chi square is given as;

$$X^2 = \sum \frac{(o-e)2}{E}$$

Where; X^2 = chi square

O= observed frequency

e= expected frequency

Level of confidence/degree of freedom

When employing the chi-square test, a certain level of confidence or margin of error has to be assumed. More also, the degree of freedom in the table has to be determined in simple variable, row and column distribution, degree of freedom is: df= (r-1) (c-1)

Where; df= degree of freedom

r= number of rows

c= number of columns

In determining the critical chi-square value, the value of confidence is assumed to be ay 95% or 0.95 a margin of 5% or 0.05 is allowed for judgment error

FLOW CHART OF PRESERVATION OF SMOKING FISH

CAT FISH

CUTTING

WASHING

SALTING

SMOKING

RECIPE	**QUANTITY**
Cat Fish	10 piece
Water	500gram
Salt	25gram

METHOD OF PRESERVATION OF SMOKING CAT FISH

The cat fish was cut then wash clean water and remove all the fish Gills and little salt added to it and then put on half drum for smoking and can keep product in good condition for twenty four hour.

Smoking also accelerate rancidity of fat and so Reduce Digestibility of Fat Product.

FLOWCHART OF PRESERVATION OF SUN DRYING FISH

TILAPIA FISH

CUTTING

WASHING

SALTING

SUN DRYING

RECIPE	**QUANTITY**
Tilapia Fish	9piece
Water	500gram
Salt	25 gram

METHOD OF PRESERVATION OF SUNDRYING TILAPIA FISH

The Tilapia fish was cut then wash with clean water and remove all the fish Gills and little salt was added to it and then put into the sun for Drying and can keep product in good condition for twenty four hours.

Sun drying also accelerate rancidity of Fat and so Reduce Digestibility of Fat Product.

FLOWCHART OF PRSERVATION OF SALTING

TITUS FISH

↓

CUTTING

↓

WASHING

↓

SALTING

RECIPE	**QUALTITY**
Titus fish	7piece
Water	500gram
Salt	25gram

METHOD OF PRESERVATION OF SALTING TITUS FISH

The Titus fish was cut then wash with clean water and remove all the Gills and little salt was added to it

This principle is to keep the fish for a long time in brine.

CHAPTER FOUR

FINDINGS/DISCUSS

4.1 INTRODUCTION

This chapter deals with the presentation and analysis of the result obtained from questionnaries. The data gathered were presented according to the order in which they were arranged in the research question and simple percentage were used to analyze the demographic information of the respondents while the chi square test was adopted to test the research hypothesis.

4.2 ANALYSIS OF DEMOGRAPHIC DATA RESPONDENTS

TABLE 1: GENDER OF REPONDENTS

		Frequency	Percent	Cumulative Percent
Valid	Male	15	50	50.0
	Female	15	50	50.0
	Total	30	100.0	

Source: Field Survey 2025

Table 1 above shows the gender distribution of the respondent used for this study. Out of the total number of 15 respondents which represent 50 percent of the population are male. 15 Respondent which represent 50 percent of the population are female.

TABLE 2: AGE RANGE OF RESPONDENTS

		Frequency	Percent	Cumulative Percent
Valid	20-30 years	5	16	16
	31-40years	10	33	33
	41-50years	5	16	16
	51-60years above	5	16	16
	60years	5	16	100.0
	Total	30	100.0	

Source: Field Survey 2025

Table 2 above shows the age grade of the respondent used for this study. Out of the total number of 30 respondents, 5 respondents which represent 16 percent of the population are between 20-30years. 10 respondent which represent which represent 33 percent of the population are between 31-40years. 5 respondents which represent 16 percent of the population are between 41-0years. 5 respondent which represent 16 percent of the population between 51-60years. 30 respondent which represent 30.0 percent of the population are above 60years.

Table 3: EDUCATIONAL BACKGROUND OF RESPONDENTS

		Frequency	Percent	Cumulative percent
Valid	FSLC	5	16.6	16.6
	WASSCE/GCE/NECO	5	16.6	16.6
	OND/HND/BSC	10	33	33
	MSC/PGD/PHD	5	16.6	16.6
	OTHERS	5	16.6	100.0
	Total	30	100.0	

Source: Field Survey 2025.

Table 3 above shows the educational background of the respondents used for this study. Out of the total number of 30 respondents, 5 respondents which represent 16 percent of the population are FSLC holders. 5 which represent 35 percent of the population are SSCE/GCE/WASSCE holders. 10 which represent 35 percent of the population are OND/HND/BSC holder's. 5 respondent which represent 16 percent of the population are MSC/PGD/PHD holders. 5 which represent 16 percent of the population had other type of educational qualifications.

TABLE 4: MARTIAL STATUS

		Frequency	Percent	Cumulative Percent
Valid	Single	10	3.3	33
	Married	5	16.6	16.6
	Divorced	5	16.6	16.6
	Widowed	10	33	33
	Total	30	100.0	100

Source: Field Survey 2025.

Table 4 above shows the martial status of the respondents used for this study. 10 respondent which represent 33 percent of the population are single. 5 respondent which represent 16.6 percent of the population are married. 5 respondent which represent 16.6 percent of the population are divorced. 10 respondent which represent 33 percent of the population are widowed.

4.3 SENSORY EVALUATION

ON THE PROCESSING AND PRESERVATION OF FISH IN REFERENCE OF SALTING, SMOKING AND SUNDRYING

SMOKING 30% FISH

Grade	Very satisfactory	Satisfactory	Fairly satisfactory	Unsatisfactory
Colour	10	8	12	
Texture	8	11	11	
Taste	12	12	6	
Flavour	10	8	12	
Over all acceptability		10	10	

SENSORY EVALUATION

ON THE PROCESSING AND PRESERVATION OF FISH IN REFERENCE OF SALTING, SMOKING AND SUNDRYING

SALTING 30% FISH

Grade	Very satisfactory	Satisfactory	Fairly satisfactory	Unsatisfactory
Colour	10	8	12	
Texture	8	11	11	
Taste	12	12	6	
Flavour	10	8	12	
Over all acceptability		10	10	

SENSORY EVALUATION

ON THE PROCESSING AND PRESERVATION OF FISH IN REFERENCE OF SALTING, SMOKING AND SUNDRYING

SUNDRYING **30% FISH**

Grade	Very satisfactory	Satisfactory	Fairly satisfactory	Unsatisfactory
Colour	8	12	10	
Texture	10	8	12	
Taste	10	11	9	
Flavour	9	12	9	
Over all acceptability		10	10	

When fish are captured or harvested for commercial purposes, they need some prepossessing so they can be delivered to the next part of the marketing chain in a fresh and undamaged condition. This means, for example, that fish vessel need handling so they can be stored safely until the boat lands the fish on shore. Typical handling processes are (FAO, 2011).

- Transferring the catch from the fishing gear (such as a trawl, net or fishing line) to the fishing vessel
- Holding the catch before further handling
- Sorting and grading
- Bleeding, gutting and washing
- Chilling

- Storing the chilled fish

- Unloading, or landing the fish when the fishing vessels returns to port

The number and order in which these operations are undertaken varies with the fish species and the type of fishing gear used to catch it, as well as how large the fishing vessel is and how long it is at sea, and the nature of the market it is supplying (FAO,2011). Catch processing operations can be manual or automated. The equipment and procedures in modern industrial fisheries are designed to reduce the rough handling of fish, heavy manual lifting and unsuitable working positions which might result in injuries (FAO, 2011).

4.4 HANDLING LIVE FISH

An alternative, and obvious way of keeping fish fresh is to keep them alive until they are delivered to the buyer or ready to be eaten. This is a common practice worldwide. Typically, the fish are placed in a container with clean water, and dead, damaged or sick fish are starved to reduce their metabolic rate. This decreases fouling of water with metabolic products (ammonia, nitrite and carbon dioxide) that become toxic and make it difficult for the fish to extract oxygen (FAO, 2011).

Fish can be kept alive in floating cages, wells and fish ponds. In aquaculture, holding basins are used where the water is continuously filtered and its temperature and oxygen level are controlled. In China, floating cages are constructed in rivers our of palm woven baskets, while in South American simple fish yards are built in the backwaters of rivers (Bremner, 2003). Live fish can be transported by methods which range from simple artisanal methods where fish are placed in plastics bags with an oxygenated

atmosphere, to sophisticated systems which use trucks that filter and recycle the water, and add oxygen and regulate temperature (FAO,2011).

The time lag between catching, transporting and landing encourages fish flesh quality deterioration and short shelf-life for such fish. This could be prevented by observing the following rules:

1. Kill the fish immediately after been caught by piercing the head with a needle or any sharp object, this prolong the period the fish will stiffen

2. Cut the fish immediately and remove the gills and cut off the head.

3. Wash with clean running water.

4. Put the fish on ice in insulated boxes. In the absence of ice, the fish should be kept in the shade in clean containers away from intense sunlight.

5. Get the fish as fast as possible to the landing area for further preservation and sales.

4.4.1 REMOVAL OF THE SCALES

For a whole flat fish, wash and cut off the head. Holding the fish by the tail and using a sharp knife, Scale it by scrapping toward the head. Scrap until all the scales are removed (UNDFFW,2003). Turn the fish and scale the other side. (Fig. 2a and 2b).

4.4.2 CUTTING

Cutting the removal of the guts (instestines) of the fish. Cutting should be carried out on fish no matter what method of preservation is going to be applied. After gutting, the fish should be washed thoroughly with clean running water. Cutting and washing of the fish helps to prevent bacterial attack before and during processing, preservation and storage (Silva,2015).

4.4.3 FILLETING OF FISH

The processing industry also adopted freezing of fish in the form of fillets at time when prawns are not available. Fillets are nothing but the strips of flesh cut parallel to the backbone of the fish. Fishes like milk fish, cat fish, perches, mullets, carps, eel,etc (Bekker-Nielsen, 2005) are suitable for filleting and freezing (Luten et al., 2006). Filleting can be done by hand which is economical or by using a filleting machine. Fillets may be with or without skin and it fetches a much higher price in the luxury market.

Fillets are dripped in brine to enhance their appearance and to reduce the amount of drip and it also gives a salty flavor (Bekker-Nielsen, 2005). The freezing of fillets can be an individual quick freezing of block freezing (Zohar et al., 2001).

After dropping in brine, the fillet wrapped in polythene sheet are frozen in contact plate freezer at -350C to 400C. In block freezing the fillets in known weight 500gram, 1Kg, 2Kg are packed in polythene bags lined with wax and sufficient quantity of glazed water is poured to cover the fillets (Bremner, 2003). The fillets are put in a freezer at -35 to 400C and stored at -230C.

4.5 SOME PROCESSED FISH PRODUCTS

4.5.1 FISH MINCE

This can be defined as flesh separated in a communited form, from the frame, scale, bone and fins of fish. Fish mince can be prepared either mechanically by the use of flesh bone separator or non-mechanically (Royal society of Edinburgh, 2004).

A flesh/bone (or meat/bone) separators also called Deboning machines can be used to retrieve flesh attached to bones and frames of fish and thus

make them better utilized instead of discarding them as a waste (Garcia et al., 2015). Prepared fish by removing the head, skin, bone, internal organs such as a gut, kidney, liver, air bladder and blood vessels before passing it into flesh/bone separator: when this prepared fish are fed into the machine it is squeezed between the feed belts and perforated drums in such a way as to allow only flesh to pass through, while the bones and skin are collected separately. These are utilized thus maximizing the profit from the landings and fish is still made available cheaply to the consumers (Zohar et al.,2001).

Minced fish is obtained from filleting leftovers to headed and gutted fish using a bone/flesh (mat-bone) separator to remove bones from the edible flesh. 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 (Sun and Da-Wen,2008).

4.5.2 SURIMI

This is a wet concentrate of proteins of fish muscle that is mechanically deboned water washed fish flesh. It is prepared from marine fish. Minced fish is cooled water washed to remove fat and water soluble components (Garcia et al.,2015). 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 hamburger. Difference between minced fish and surimi is that while minced fish is the fish flesh which is separated from bones and skin (usually mechanically) surimiis prepared after minced fish have been washed in water to remove fat and wet soluble components (Royal society of Edinburgh, 2004).

4.5.3 FISH SAUCE

This is an amber-colored liquid extracted from the fermentation of fish with sea salt. It is used as a condiment in various cuisines. Fish sauce is a

staple ingredient in numerous cultures in Southeast Asia and the coastal regions of East Asia and features heavily in Burmese, Cambodian, Filipino, Thai, Lao and Vietnamesecuisines. It also was a major ingredient in ancient European cuisine, but is no longer commonly used in those regions (Royal society of Edinburgh, 2004).

In addition to being added to dishes during the cooking process, fish sauce is also used as a base for a dipping condiment, prepared in many different ways in each country, for fish, shrimp, pork, and chicken. In parts of southern Chain, it is used as an ingredient for soups and casseroles. Fish sauce, and its derivatives, impart anumami flavor to food due to their glutamate content (Tys and Pieters, 2009).

4.5.4 FISH MEAL

Fishmeal, is a commercial product mostly made from fish that are not generally used for human consumption; a small portion is made from the bones and offal left over from processing fish used for human consumption, while the larger percentage manufactured from sustainable, managed, and monitored fish stocks of wild caught, small marine fish (FAO,2008). It is powder or cake obatined by drying the fish or fish trimmings, often after cooking, and then grinding it. If the fish used is a fatty fish it is first pressed to extract most of the fish oil (Garcia et al.,2015).

CHAPTER FIVE

SUMMARY CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

Demand for fishery product is rising globally, therefore operative preservative techniques are needed food irradiation is considered a successful techniques not only in activating pathogenic microorganism without decreasing food quality. Food stuff are usually irradiated by gamma irradiation generated by a radio scope source. The amount of energy absorbed by the foodstuff during irradiation is called the absorbed does, this chapter present a comprehensive review of irradiation research for fish and fishery products. It also examine the impact of irradiation on the survival of spoilage and pathogenic microorganism gamma irradiation of 2.7kg is considered a successful method of preservation since it can reduce the population of food borne bacterial pathogens as well as many fish specific bacterial spoiler and can extend the shelf life of fish.

5.2 CONCLUSION

Fish preservation and processing is a very important aspect of the fisheries. Normally the fish farms or other fish capturing sites are located far off from the market place and there is chance of fish decomposition and the uncertainties of their sales in market. When the fishes are caught in numbers, greater than the amount of consumption, their preservation becomes a necessity for their future use. Preservation and processing, therefore become a very important part of commercial fisheries. It is done in such a manner that the fishes remain fresh for a long time, with a minimum loss of flavour, taste, odour, nutritive value and the digestibility of their flesh.

5.3 RECOMMENDATION

The preservation and processing of fishes should be taken seriously by all as to avoid wasting of the fish products.

Government should invest more on the fish processing as a lots of Economic benefits could be derived from proper processing and preservation of the fishes. It is recommended that more research should be carried out on the processing of the fishes as not much research work has been done on it.

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APPENDIX I

Department of Hospitality

Management,

Institute of Applied Science,

Kwara State Polytechnic,

Ilorin,

Kwara State,

23rd June, 2025

Dear Sir/Madam

I am a student of Hospitality Management of the above mentioned schools. I am carrying out a research on the processing and preservation of fish in reference of salting, smoking and sun drying.

May I solicit for your help in answering the question below and would like to assure you that every information you give will be treated in strictest confidence and will be solely for academic purpose.

Thanks

Yours Sincerely,

APPENDIX II

SECTION A

i. Gender of Respondent: a. Male ( ) b. Female ( )

ii. Age range of Respondent: a. 20-30years ( ) b. 31-40years ( ) c. 41-50 years ( ) d. 51-60years ( ) e. above 60 years ( )

iii. Martial Status of the Respondent: a. Married ( ) b. Single ( ) c. Divorced ( ) d. Widowed ( )

iv. Educational background of the Respondent:

a. FSLC ( ) b. WASSCE/GCE/NECO ( ) c. OND/HND/BSC ( )

d. MSC/PGD/PHD ( ) e. OTHERS ( )

v. Category of respondent: a. Civil Servant ( ) b. Self-employed ( ) c. Student ( ) d. Unemployed ( )

SECTION B

SENSORY EVALUATION

ON THE PROCESSING AND PRESERVATION OF FISH IN REFERENCE OF SALTING, SMOKING AND SUNDRYING

30% FISH

Grade	Very satisfactory	Satisfactory	Fairly satisfactory	Unsatisfactory
Colour				
Texture				
Taste				
Flavour				
Over all acceptability				