ASSESSMENT OF PROXIMATE ANALYSIS OF PROCESSED AFRICAN CATFISH (ClariaSs Gariepinus) USING CHARCOAL AND FIREWOOD

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A PROJECT SUBMITTED TO
THE DEPARTMENT OF AGRICULTURAL SCIENCE EDUCATION,
NIGER STATE COLLEGE OF EDUCATION, MINNA

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DEDICATION

The project is dedicated unto almighty God and our parent, brothers and sisters whose financial and moral support immeasurable, we pray that God bless them all.

ACKNOWLEDGEMENT

With special thanks to God Almighty who gave us live, his grace and help us to start and complete this work.

Our sincere gratitude appreciation and thanks are due to our project supervisor in respect of Dr. Mohammed Ibrahim who gave us constructive advice and for the time he took to go through this project and make necessary correction at each chapter and also the Head of the department in honour of Mallam Mohammed Audu Bokani and the entire staff of agricultural science department.

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We thank you all (Amen).

ABSTRACT

Processing and preservation of fish in Nigeria is poor, this can be attributed to the bad processing technique and poor preservation facilities. The study tends to determine the proximate analysis of processed African Catfish using charcoal and firewood. The study uses the departmental farm in Niger State College of Education, Minna for its experimental site. 7 healthy African Catfish with average of 5 kilogram were purchased and transported to the departmental farm. Two methods of processing and preservation which are drying and smoking using Modified Drum Kiln (MDK) and Insulated Drying Oven (IDO) with different sources of energy within the period of 4 hours and 50 – 60°C temperature are employed. To measure the differences between the two processes, the moisture content, ash of the samples, crude lipid extraction and crude protein content were established parameters. The results shows variation between fish dried with charcoal and firewood. The finding reveals that moisture content of fish dried with firewood is higher than charcoal, the crude protein of fish dried with charcoal is higher than firewood, the crude lipid of fish dried with charcoal is higher than firewood, the crude fibre content of fish dried with firewood is higher than charcoal and the ash content of fish dried with firewood is higher than charcoal. It is therefore recommended that government, non-governmental organization, cooperative societies and fish processors should work hand in hand and embraced the use of charcoal for processing fish.

TABLE OF CONTENT

CHAPTER THREE

Materials and Methods

CHAPTER FOUR

Representation and Interpretation of Data

CHAPTER FIVE

Summary and Recommendation

CHAPTER ONE

1.0 INTRODUCTION

Most fish are ectothermic (cold-blooded), allowing their body temperatures to vary as ambient temperatures change, though some of the large active swimmers like white shark and tuna can hold a higher core temperature.

They are an important resource for humans worldwide, especially as food. Commercial and subsistence fishermen hunt fish in wild fisheries or farmed in ponds or in cages in the ocean (aquaculture). They are also caught by recreational fishers, kept as pets, raised by fish keepers, and exhibited in public aquaria.

Fish is highly nutritious and provides protein, vitamins and minerals body. The protein from fish is highly perishable due to poor handling, processing and preservation. Fish spoilage manifests itself physically in numerous ways. In terms of smell, spoiled fish will generally have a fishy, sour, or ammonia-like stench. Appearance-wise, spoiled fish may appear to be dry or mushy in certain areas, and the gills may have slime. Spoiled fish will also have flesh that is soft, or does not spring back when pressed upon. Typically, spoiled fish will also have a green or yellowish discoloration; however, this arises not from spoilage metabolites, but rather oxidation of the oxygen transporters in fish blood (myoglobin to metamyoglobin) during frozen storage or from prolonged or unnecessary exposure of the fish to air.

Spoilage and freshness are the two qualities that have to be clearly defined. This change may be graded as the change from absolute freshness to limits of acceptability to unacceptability.

The high post mortem pH of fish flesh is caused by the fact that fish flesh is low in carbohydrates (less than 0.5%) in the muscle tissue and that only small amounts of lactic acid are produced after death. This allows pH sensitive organisms such as *Shewanella putrefaciens* to grow in seafood but not in other meats.

1.2 STATEMENT OF PROBLEM

African Catfish (Clarias gariepinus) is the most cultured, consumed and cherished freshwater fish in Nigeria both in fresh and dried forms, however most of these fish is lost due to poor preservation and processing techniques and facilities hence the need to develop efficient and effective techniques to process and preserve it.

1.3 JUSTIFICATION

African catfish (Clarias gariepinus) is a highly nutritious and tasty fish it also has a very high moisture and lipid content which makes it a highly perishable product. This fish can be a good source of protein to human beings when properly preserved or processed.

1.4 HYPOTHESIS

There is no significant difference in the proximate composition between fish dried with charcoal and fish dried firewood.

1.5 AIM OF THE STUDY

- To determine the difference in proximate composition of African Catfish (Clarias gariepinus) processed using two different techniques with specific objectives

- Assessing proximate composition of processed African Catfish (Clarias gariepinus) using firewood and charcoal.
- Assessing the proximate composition of African Catfish (Clarias gariepinus) processed with firewood and charcoal

CHAPTER TWO

LITERATURE REVIEW

2.1 FISH SPOILAGE

A fresh product is defined as the one whose original characters remain unchanged. Spoilage therefore is the indicative of post harvest change.

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. 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.

Spoilage bacteria are the specific bacteria that produce the unpleasant odours and flavours associated with spoiled fish. Fish normally host many bacteria that are not spoilage bacteria, and most of the bacteria present on spoiled fish played no role in the spoilage.(Huss , 1988) To flourish, bacteria need the right temperature, sufficient water and oxygen, and surroundings that are not too acidic. (Huss, 1988)

Compared to other foods, fish is unique as a substrate for microbial growth. This uniqueness stems from several important factors: the poikilotherm nature of fish, a high post mortem pH in the flesh (typically greater than 6.0), the presence of non-protein-nitrogen (NPN) in large quantities, and the presence of trimethylamine oxide (TMAO). (Gram *et al.*1995)

The poikilotherm nature of fish selects for bacteria that can thrive in a wide range of temperatures. For example, the microflora of temperate water fish is dominated by psychrotrophic Gram-negative, rod-shaped bacteria such as those

found in the genera *Pseudomonas* and *Moraxella*, with only varying proportions of Gram-positive organisms such as *Bacillus*. (Gram *et al.*1995).

The NPN fraction of the fish flesh consists of low-molecular-weight water-soluble nitrogen contains compounds, particularly free amino acids and nucleotides, that allow it to serve as a readily available bacterial growth substrate. Decomposition of these compounds is responsible for many of the off-odors and off-flavors typically found in spoilage. For example, the breakdown of cysteine and methionine by certain microbes, both sulfur-containing amino acids, forms hydrogen sulfides and methylmercaptane respectively which causes undesirable odors to emanate from spoiled fish. (Gram et al.1995)

2.2 FISH PRESERVATION AND PROCESSING TECHNIQUES

Fish curing includes fish drying, salting, smoking, and pickling, or by combinations of these processes have been employed since ancient times. Modern freezing and canning methods have largely supplanted older methods of preservation. Fish to be cured are usually first cleaned, scaled, and eviscerated. Fish are salted by packing them between layers of salt or by immersion in brine. The fish most extensively salted are cod, herring, mackerel, and haddock. Smoking preserves fish by drying, by deposition of creosote ingredients, and, when the fish are near the source of heat, by heat penetration. (Fao, 2008).

Preservation techniques are needed to prevent fish spoilage and lengthen shelf life. They are designed to inhibit the activity of spoilage bacteria and the metabolic changes that result in the loss of fish quality.

2.3 FISH SMOKING

Smoking is the process of flavoring, browning, cooking, or preserving food by exposing it to smoke from burning or smoldering material, most often wood. Meat, fish, and lapsang souchong tea are often smoked (Fritz , *et al* 1980).

In Europe, alder is the traditional smoking wood, but oak is more often used now, and beech to a lesser extent. In North America, hickory, mesquite, oak, pecan, alder, maple, and fruit-tree woods, such as apple, cherry, and plum, are commonly used for smoking. Other biomass besides wood can also be employed, sometimes with the addition of flavoring ingredients. Chinese tea-smoking uses a mixture of uncooked rice, sugar, and tea, heated at the base of a wok. (Fritz , *et al* 1980)

Some North American ham and bacon makers smoke their products over burning corncobs. Peat is burned to dry and smoke the barley malt used to make whisky and some beers. In New Zealand, sawdust from the native manuka (tea tree) is commonly used for hot smoking fish. In Iceland, dried sheep dung is used to cold-smoke fish, lamb, mutton and whale. (Fritz , *et al* 1980)

Historically, farms in the Western world included a small building termed the smokehouse, where meats could be smoked and stored. This was generally well-separated from other buildings both because of the fire danger and because of the smoke emanations.

The smoking of food directly with wood smoke is known to contaminate the food with carcinogenic polycyclic aromatic hydrocarbons which may cause an intestinal type of gastric adenocarcinoma. (Fritz , *et al* 1980)

Smoking can be done in four ways: Cold Smoking, Warm Smoking, Hot Smoking, and through the employment of liquid smoke (Fellows, *et al* 2017) However, these methods of imparting smoke only affect the food surface, and are unable to preserve food, thus, smoking is paired with other microbial hurdles, such as chilling and packaging to extend food shelf-life. (Fellows, 2017)

2.3.1 FIREWOOD SMOKING

Firewood is any wooden material that is gathered and used for fuel. Generally, firewood is not highly processed and is in some sort of recognizable log or branch form, compared to other forms of wood fuel like pellets or chips. Firewood can be seasoned (dry) or unseasoned (fresh/wet). It can be classed as hardwood or softwood.

Firewood is a renewable resource. However, demand for this fuel can outpace its ability to regenerate on a local or regional level. Good forestry practices and improvements in devices that use firewood can improve local wood supplies.

Harvesting or collecting firewood varies by the region and culture. Some places have specific areas for firewood collection. Other places may integrate the collection of firewood in the cycle of preparing a plot of land to grow food as part of a field rotation process. Collection can be a group, family or an individual activity. The tools and methods for harvesting firewood are diverse (UNH , 2006).

2.3.2 CHARCOAL SMOKING

Charcoal is the lightweight black carbon and ash residue hydrocarbon produced by removing water and other volatile constituents from animal and vegetation

substances. Charcoal is usually produced by slow pyrolysis — the heating of wood or other substances in the absence of oxygen The advantage of using charcoal instead of just burning wood is the removal of the water and other components, which allows charcoal to burn to a higher temperature, and the fact that the product of its combustion is mainly carbon dioxide, resulting in very little smoke (regular wood gives off a good amount of steam and un-burnt carbon particles - soot - in its smoke (Chisholm, 1910).

2.4 IMPORTANCE OF FISH SMOKING

Smoked fish being a foreign exchange earner for Nigeria, researchers are concerned about the quality of products, this was apparent from the investors forum that was jointly organized recently by the Nigerian institutes for oceanography and Marine Research and the Raw Materials Research and Development Council, where participants called for better handling, processing and packaging of products to meet the required standards set by authorities in the countries of export (Oyeleye, 2003). Thus, as dried fish continues to occupy its important place as a delicacy in the dishes of Nigerians. While drying of fish could extend its keeping quality thereby increasing the availability of fish all year round (Afolabi *et al,* 1984). Fish smoking and drying naturally developed along the coastal fishing communities, the main objective being preservation of the catch for use over a long period of time (Adesulu, 2007). The traditional methods of processing are often inefficient and unhygienic involving substantial post harvest losses in terms of mould, fragmentation, infestation by flies and beetles, loss of quality by charring etc., the traditional or conventional methods can be improved and losses can be reduced by the use of NIOMR smoking kiln

and oven. It is instructive that the method has the effect of imparting a pleasant flavour to the product besides the preservative effect of the smoke itself (Burgress *et al*, 1965).

The most important factor affecting the quality of a fish product is the freshness of the raw fish immediately prior to processing (Gokoglu *et al.*, 2004). Poor quality raw fish produces poor quality end product. Processing can only help to slow down the rate of deterioration and using spoiled fish as the raw material can only produce poor quality product (Wu and Mao, 2008). Poor quality product due to fish being damaged by difficult handling of the fish on wire nets used to support them over the fire, loss of smoke and heat, resulting in uneven smoking, limited capacity of smoking larger volumes of fish, time consuming in terms of amount of time needed to handle the fish in smoking (Puwastien *et al.*, 1999).

CHAPTER THREE

MATERIALS AND METHODS

3.1 LOCATION OF THE STUDY AREA

The study was conducted in the Departmental farm of the Niger State College of Education Minna the capital of Niger State Located in the savanna region of Nigeria.

3.2 PROCUREMENT OF FISH

Seven (7) African Catfish of average 5 kilogram was purchased from fish vendors around Minna City gate along Paiko road opposite Doko hotel. The fish was transported to the departmental farm.

3.3 DRYING/SMOKING OF FISH

The fish was gutted, washed salted. The fish was divided into two parts; one part was dried using a Modified Drum Kiln (MDK) which uses wood as a source of fuel and the other part using Insulated Drying Oven (IDO) which uses charcoal as source of fuel (heat). The drying/smoking process lasted for about 4 hours at a temperature range of about 50-60°C.

3.4 ASSESSMENT OF PROXIMATE COMPOSITION OF DRIED/SMOKED FISH

The moisture content and ash of the samples was be assayed as described by the AOAC (2000) while crude lipid extraction will be carried out using the AOAC (2000) but with some modifications (Sutharshiny, 2011).

Crude protein content was determined using the micro kjeldahl method (Sutharshiny, 2011).

CHAPTER FOUR

PRESENTATION AND INTERPRETATION OF DATA

4.1 PRESENTATION OF DATA

Table 1. shows the proximate composition of Clarias gariepinus processed using charcoal and firewood respectively.

Fuel source	% Moisture	% Crude Protein	% Crude Lipid	% Ash	% Crude Fibre
Charcoal 1	5.83	68.25	24.67	17.82	0.25
Charcoal 2	6.77	68.60	26.23	16.98	0.10
Firewood 1	19.77	67.37	14.92	18.70	1.15
Firewood 2	17.56	66.50	17.99	16.63	0.15

4.2 DISCUSSION OF FINDINGS

Fish dried with charcoal had the least moisture content 5.88% and 6.77%, while fish dried with firewood had the highest moisture content 19.77% and 17.56%.

In terms of crude protein content, charcoal dried fish had the highest 68.25% and 68.60% while firewood dried fish had the lowest 67.37% and 66.50%.

With respect to Crude Lipid, Charcoal dried fish had the highest value 24.67% and 26.23% while firewood dried fish had the least 14.92% and 17.99%.

For Ash content charcoal dried fish has 17.82% and 16.98% while firewood dried fish have 18.70% and 16.63%.

In Crude fibre content, charcoal had 0.25% and 0.10% while firewood had 1.15% and 0.15%.

CHAPTER FIVE

SUMMARY AND RECOMMENDATIONS

5.1 SUMMARY

The result obtained from this study shows that the two processing methods had a great impact on the proximate composition of fish.

There was not much significant difference between the two processing methods; however fish processed with charcoal had better results than fish processed with firewood.

5.2 RECOMMENDATIONS

- The government in collaboration with some non-governmental organizations and cooperative societies should provide or subsidize charcoal kiln to fish processors.
- Fish processors should be enlightened and informed about the modern techniques of fish processing
- Fish processors should embrace drying of fish with charcoal oven rather than the traditional smoking method with firewood.

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