



Techno Science Africana Journal

Journal homepage: www.technoscienceafricana.com



NUTRIENTS AND MICROBIAL ASSESSMENT OF SMOKE-DRIED FISH IN TWO MAJOR MARKETS IN KANO STATE, NIGERIA

M.A.Dambatta¹, Umar A. and I. A.U. Shaaibu²

* Department of Forestry, Fisheries and Wildlife, Kano University of Science and Technology Wudil

** Department of Agricultural Extension, Kano University of Science and Technology Wudil
Corresponding

ARTICLE INFO

Keywords: Nutrient, Microbial Assessment, Market, Kano State,

Correspondence author:

authormansirfish12@gmail.com

Phone:

ABSTRACT

*“Nutrients And Microbial Assessment Of Smoke-Dried Fish in Two Major Markets in Kano State which includes Galadima Market and Sabon-Gari Market, Nigeria” aim at examining the nutrients and microbial load on smoked and sun dried fish. The study restricted to the study of *Clariasgariepinus* and *Tilapia zilli*, in two major markets. The materials used for the research were Aluminum plastic dishes, Oven, Desecrator, and Measuring scale/weighing balance, Blender. Duncan Variance (1955), and multiple range test was used to determine the significant of the mean differences. Data collected from each parameter was subjected to computation of analysis of variance (ANOVA). The results showed that the smoke fish had high nutrient contents compared to dried one. The effect of smoke duration on weight of fish smoked with mud smoking kiln indicates that *Tilapia zilli* have high efficiency than *Clariasgariepinus* with 0.36kg/hr and 0.3kg/hr respectively. The composition of market smoked fish and experimental smoked fish shows that smoked catfish had highest dry matter (98.40), crude protein (68.95^a), and ash (8.41^b), while GGM Smoked Tilapia has high crude lipid (17.96^a), GGM Smoked Tilapia had highest Nitrogen free extra and crude fibre (9.51^a) and 3.78 respectively. The Microbial of market smoked fish and experimental smoked fish proved that Sabongari Smoked Tilapia had highest Bacterial load X10-3cfu/ml 2.1. While Galadima Smoked Tilapia has high Fungi load X103CFU/ml 2.9.*

1.0 INTRODUCTION

Fish is the major source of food for humans providing a significant portion of the protein intake in the diets of a large proportion of the people, particularly in developing countries. Fish are a cheap sources of animal protein with little or no religions rejection, which gives it an advantage over pork or beefs (Eyo, 2001, Ligia 2002). Fish have a level of essential sulphur

containing amino acids such as cysteine, methionine and lysine which are limiting in some other protein sources in Nigeria (Osuji, 1973). FAO estimated that fish provides 22% of protein intake and exceed 50% in the poorest countries where animal is expensive and scarce (FAO 2003). Low cholesterol and tender flesh (Eyo, 2001).

Fresh but more often-smoked sun dried fish even powdered fish, is a critical source of dietary protein and micronutrients for many isolated communities in rural areas (Anon, 2000). According to Bene and Heck (2005) nutritionally, fish is one of the extremely important direct sources of protein and micronutrients for millions of people in Africa. Fish also contributes indirectly to national food self – sufficiency through trade and exports. Fish is a very perishable commodity; it spoils quickly because of high ambient temperature in the tropics, which hastens fish spoilage by accelerating the activities of bacterial enzymes and chemical oxidation of fat in fresh fish (Eyo, 2001).

Statement Of Problem

Spoilage of food products is due to chemical, enzymatic or microbial activities. Techniques must prevent microbial spoilage of food without affecting its quality and nutritional flavor due to loss of free amino acids may be a problem. One-fourth of the world's food supply and 30% of landed fish are lost through microbial activity alone (Luna, 1983). With the ever growing world population and the need to store and transport the food from one place to another where it is needed, food preservation becomes necessary in order to increase its shelf life and maintain its nutritional value, texture and flavor.

Justification Of The Study

Post-harvest spoilage has hindered the even distributional and supply of fish protein to Nigerians; therefore, the need to preserve fish for prolonged shelf life, creation of employment opportunity, necessitated this study. The health of the fish consumers may be affected as they eat fish with heavy microbial load. Hence it is

need to examine the microbial load of smoked and sundried fish sold in the markets.

1.3 Objectives Of The Study

The main objectives of the study is to examine the nutrients and microbial load on smoked and sun dried fish, the efficiency and problems associated with smoked fish.

1.3.0 The Specific Objectives Are

1. To examine the nutrients value of smoked and sun dried fish.
2. To determine the microbiological load on smoked and sun dried fish sold in two major markets in Kano state.

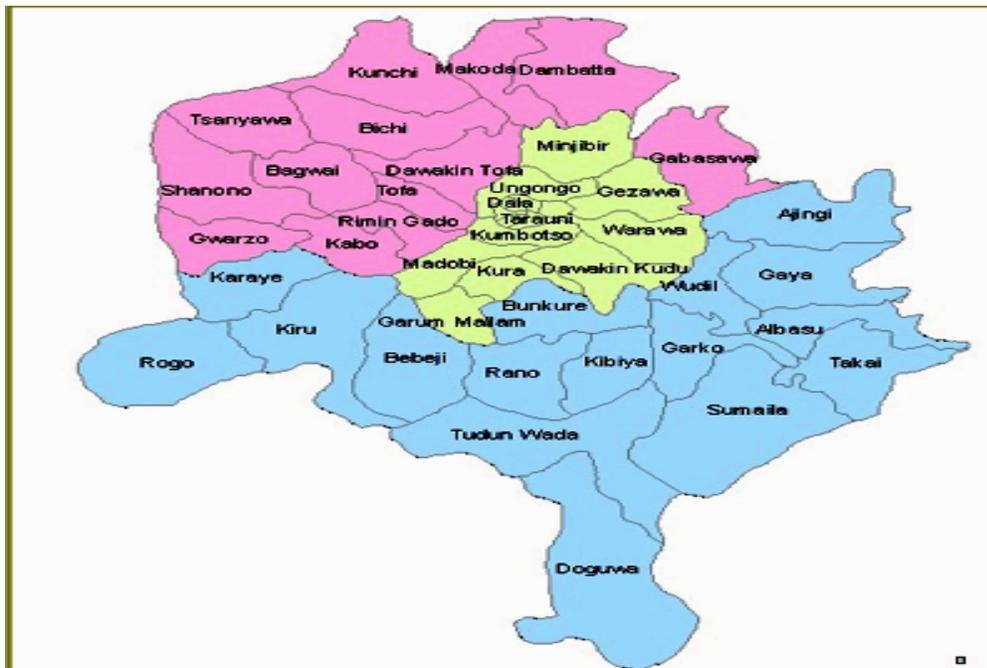
1.4 Scope Of The Study

This research is restricted to the study of *Clarias gariepinus* and *Tilapia zilli*, in two major markets in Kano state

3.0 Materials and Method

3.1 Study Area

The study was conducted in Kano State; where fresh water fishes have a very old history due to availability of numerous fresh water bodies in the State. The State lies on Latitude 10°33'N to 12°37'N and Longitude 7°40'E to 9°29'E. It is within the Sudan-Savannah zone; the total land area of the State is 20,709 square kilometers. The mean daily maximum and minimum temperature are 91.6°F (33.1°C) and 60.6°F (15.85°C) respectively. Kano State is bordered to the north and northwest by Katsina State, to the east and northeast by Jigawa State, to the south by Bauchi State. It lies to the southwest of Kaduna State). Agriculture is the major employment of labor in the State with many citizens involved in farming, fishing and marketing of aquatic resources such as fish, frog either dried or smoked or fish by-products.



Map of Kano state showing study area

3.2 Determination Of Moisture Content

3.2.1 Materials Used

Aluminum plastic dishes, Oven, Desiccator, and Measuring scale/weighing balance, Blender

METHOD: Indirect distillation method was used, which is employing of dry ovens. Ouwuka (2005).

PROCEDURE: The aluminum or plastic dishes was washed thoroughly and dried in the oven, it was allowed to cool in the desiccator, each dish was weighed, the samples was kept in the weighed dish, the weight of the dish and the samples was recorded. The sample was dried in the moisture oven at 70°C – 80°C for two hours and at 100 – 135°C for four hours to obtain a constant weight.

CALCULATION OF THE MOISTURE CONTENT:

$$\% \text{ moisture content} = \frac{W^2 - W^3}{W^2 - W^1} \times 100$$

Where: W^1 = Initial weight of the employ aluminum or plastic dish

W^2 = Weight of the aluminum plastic dish + sample before drying

W^3 = final weight of aluminum/plastic fish + sample after drying % Total solid (dry matter) + 100 - %moisture.

3.3 Determination Of Ash Content

3.3.1 Materials Used

Oven, Heater or Bunsen flame, Fume cupboard, Desiccators, Tarred silica or porcelain crucible

PROCEDURE: AOAC (1990) reported that ash determination can be carried out using muffle furnace. 2-5g finely ground sample was weighed into tarred silica or porcelain crucible. The sample was charred on a heater or Bunsen flame inside a fume cupboard, to drive off most of the smoke. The sample was transferred into pre-heated muffle furnace at 550°C for 2-5 hours until a white or light gray ash results. The residue, when turned to black in color was moistening with a small amount of water to dissolve salts, it was dried in an oven and the ashing was repeated, cooled in a desiccator and re-weigh.

%Ash content= weight of ash/weight of original sample X100

$$= \frac{w_3 - w_1}{w_2 - w_1} \times 100$$

Where w_1 =weight of the empty dish

W_2 = weight of dish + sample before drying / ashing

W_3 = weight of dish + ash

3.4 Determination Of Crude Protein Contents

3.4.1 Material

2g of grounded fish sample, anhydrous sodium sulphate or 4 tables of kjeldahl catalyst, 1g of copper sulphate, concentrate sulphuric acid(0.5), 5 glass beads, pipette, fume cupboard, distillation apparatus 250ml volumetric flask, dissolve 1g in 200ml of rectified spirit boric acid indicator (methyl red indicator), NaoH (dissolve 450g of NaoH in 100ml of water), desiccators.

Method: micro kjeldahl method can also be use for protein determination; it is the most popular method and was developed by kjedahl, head of department of chemistry, Danish brewing company, Carlsberg.

3.5 Protein digestion

Procedure: 2g of sample was weighed into a kjedahl flask, 5g of anhydrous sodium sulphate or 4 tablet of kjeldahl catalyst was added, followed by 1g of copper sulphate and a speck of selenium or 1 tablet of kjedahl catalyst, each tablet contains 1g Na_2SO_4 + 0.05g selenium. 25ml of concentrate sulphuric acid and 5 glass beads (it prevents bumping during heating). It was placed in the fume cupboard, heated gently at first and then increased heat with occasional shaking till solution assumes a green color (temperature of digestion is above 420°C for about 30mins). The sample was cooled and any black particles showing at the mouth and neck of the flask was rinsed with distilled water, re-heated gently until the green color disappear and cooled. After cooling, the digest was transferred with several washings into a 250ml volumetric flask, distilled using Markham distillation apparatus.

3.5 Protein distillation

Onwuka, (2005), explained that protein distillation can be done through the use of distillation apparatus.

Procedure: it was steamed through the markham distillation apparatus for about 15 minutes with 5ml of boric indicator placed in 100ml conical flask containing the condenser such that the condenser tip was under the indicator. 5ml of the digest was pipette into the body of the apparatus via the small funnel

aperture and washed with distilled water followed by 60% NAOH solution. The solution was steamed for about 5-7 minutes to collect enough ammonium sulphate. The receiving flask was removed and the tip of the condenser was washed into the flask. The solution in the receiving flask was titrated using 0.1N hydrochloric acid. Nitrogen content of fish was calculated by using HCL.

$\% \text{Nitrogen} = \text{VS} - \text{VB} \times \text{Nacid} \times 0.01401 / \text{W} \times 100$

Where VS= volume(ml) of acid require to titrate sample

VB= volume(ml) of acid require to titrate blank

Nacid = normal of acid(0.1)

W= weight of sample in grams

$\% \text{crude protein} = \text{N} \times 6.25 (\text{conversion factor})$

3.6 Determination Of Crude Fibre

Material: 1g of grounded fish sample, 0.3 HCL, 1.5 N of NaOH, distilled water, 0.3N of HCL, Acetone/Alcohol, oven, furnace, weighing balance.

Procedure: 1g of sample was boiled in 0.3 HCL with 1.5 Normal of sodium hydroxide in excess and was boiled once more. The sample was filtered and washed with distilled water and re-washed with 0.3N of HCL, water, acetone respectively and ether or alcohol. It was dried in the oven and weighed with the residue (ag). The residue was transferred to a crucible and ash in the furnace at 700°C cooled and the remaining mineral residue (bg), was re—weighed.

$\% \text{crude fibre} = \text{a-b} / 1\text{g} \times 100$

3.7 BIOCHEMICAL TEST

3.7.1 Catalase test

This test was performed in a test tube. 2ml of 3% hydrogen peroxide (H_2O_2) was placed in a clean test tube. A sterile broom stick was use to pick a colony of a test organism and mixed with 2mm of 3%of hydrogen peroxide (H_2O_2) in the test tube and observed for the production of gas bubbles which indicate a positive reaction.

3.7.2 In dole test

In dole test demonstrate the ability of a certain bacteria to decompose amino acid, tryptophan to indole, which accumulate in the medium to give a red color with p-dimethylaminobenzadehyde.

The test organism was grown in peptone water and incubated at 37°C for 24 hours. The positive result of this test was indicated when a red coloration was observed in the upper most layer of the tube, when 0.5ml of Kovac’s reagent was added to 5ml of peptone water culture.

3.7.3 Citrate utilization test

Ten millimeters of Simmons citrate medium was dispensed into test tubes and sterilized by autoclaving at 121°C for 15 minutes. The test organisms were incubated at 37°C for 48 hours. A brilliant blue color indicated a positive result.

3, 7, 4 Oxidase test

A few drops of Kovac’s reagent were added to a piece of filter paper in a petri dish. Bacterial isolate was smeared onto impregnated filter paper with a wire loop. The paper was observed for purple coloration to occur in case of some isolates.

3.7.5 Motility test

A motility medium (agar with concentrate 0.2-0.5) was inoculated with the test organism by stabbing 2cm into the center of the medium at the bottom of the tube. It was incubated at 37°C for 24-48 hours. The temperature was reduced

for Pseudomonas growth. A diffuse growth from the plate of inoculation is considered as positive and restricted growth is considered as negative test.

3.8 IDENTIFICATION OF FUNGI

3.8.1 Cellular and colonial morphology

The isolated pure cultures were visualized by aseptically removing the cover of plates to see growth morphology. Wet preparation was done using lactone—phenol cotton blue as mounted and viewed under the lower power objective using x 40 high power objectives.

3.9 DATA ANALYSIS:

Data analysis variance, Duncan (1955), and multiply range test was used to determine the significant of the mean differences. Data collected from each parameter was subjected to computation and analysis of variance ((ANOVA) test followed by the least significant difference (LSD).

4.1 Results

Nutrients And Microbial Assessment Of Smoke-Dried Fish In Two Major Markets In Kano State, Nigeria

Table I: Effect Of Smoke Duration On Weight Of Fish Smoked With Mud Smoking Kiln

Fish species	SMOKING DURATION IN HRS					1 0	Efficiency of Smoking kiln
	0	2	4	6	8		
<i>Clarias gariepinus</i>	0 . 6	0 . 4	0.35	0.32	0 . 3	0 . 3	0 . 3 k g / h r
<i>Tilapia zilli</i>	0 . 3	0.28	0.25	0.23	0 . 1	0 . 1	0 . 3 6 k g / h r

Table II. Proximate Composition of Market smoked fish and Experimental smoked fish

Fish Sample	Dry Matter	Crude Protein	Crude Lipid	A s h	Crude Fibre	N F E
Smoked Catfish	9 8 . 4 0	68.95 ^a	1 6 . 1 5 ^a	8 . 4 1 ^b	1 . 3 1	2.45 ^c
GGM Smoked Catfish	9 4 . 6 0	62.71 ^{bc}	1 7 . 3 0 ^a	7 . 3 2 ^b	2 . 7 0	4.57 ^{bc}
SSM Smoked catfish	9 4 . 8 7	61.67 ^c	1 7 . 9 6 ^a	8 . 0 3 ^b	1 . 9 8	5.23 ^b
Smoked Tilapia	9 7 . 3 0	65.76 ^{ab}	1 1 . 2 5 ^b	1 2 . 3 0 ^a	3 . 6 1	5.38 ^b
GGM Smoked Tilapia	9 5 . 4 5	60.11 ^c	1 0 . 1 6 ^b	1 1 . 8 9 ^a	3 . 7 8	9.51 ^a
SSM Smoked Tilapia	9 4 . 3 6	61.35 ^c	1 0 . 2 1 ^b	1 1 . 6 7 ^a	3 . 7 1	7.42 ^a

Data with different superscripts are significantly different (p<0.05)

TABLE III: MICROBIAL LOAD ANALYSIS OF MARKET SMOKED FISH AND EXPERIMENTAL SMOKED FISH

F i s h S a m p l e	Bacterial load X10 ⁻³ cfu/ml		Fungi load X10 ³ CFU/ml	
Smoked Catfish	1	2	1	8
GGM Smoked Catfish	1	4	2	7
SSM Smoked catfish	1	8	2	3
Smoked Tilapia	1	3	1	6
GGM Smoked Tilapia	2	0	2	9
SSM Smoked Tilapia	2	1	2	6

TABLE IV.IDENTIFIED MICROBIAL OF MARKET SMOKED FISH AND EXPERIMENTAL SMOKED FISH

B a c t e r i a l	F u n g i
<i>Aeromonas</i> spp	<i>Aspergillus</i> spp
<i>Pseudomonas</i> spp	<i>A. Flavus</i>
<i>Vibrio</i> spp	<i>Rhizopus niger</i>
<i>Streptococcus</i> spp	<i>Mucors</i> spp
<i>Straphylococcus</i> spp	<i>Penicillium</i> spp

Table V: ORGANOLEPTIC EVALUATIONS

F i s h S a m p l e	T E X T U R E		APPEARANCE		A R O M A	
Smoked Catfish	6	3	7	0	6	4
GGM Smoked Catfish	6	8	7	1	6	2
SSM Smoked catfish	6	2	7	1	6	3
Smoked Tilapia	6	6	7	1	6	5
GGM Smoked Tilapia	6	9	7	3	6	7
SSM Smoked Tilapia	6	9	7	3	7	0

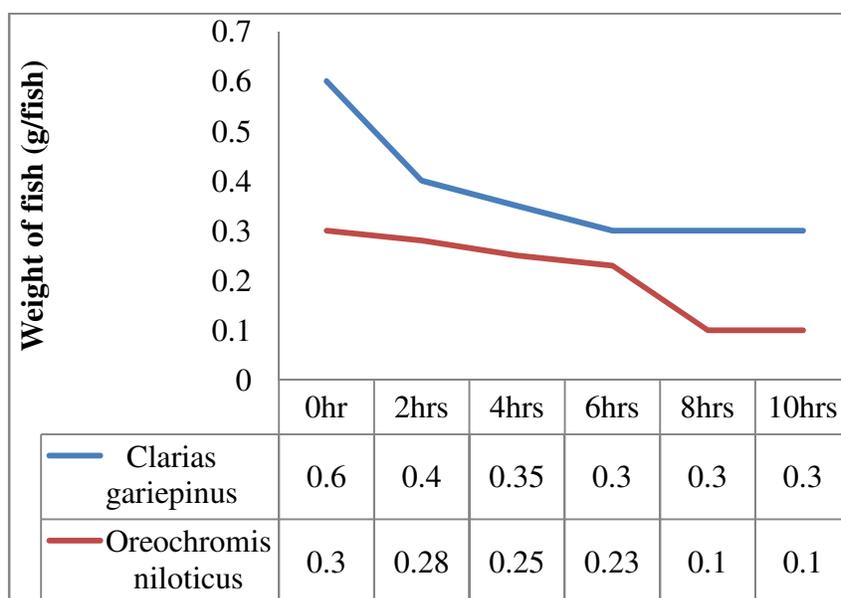


Figure I. Loss of weight during Processing Clarias gariepinus and tilapia zilli using Mud smoking Kiln

4.2 DISCUSSION

The nutrients composition of the fish two fish species processed were higher than those purchased from the two markets which indicated that the fish species were well processed. According to Eyo (1991) the need to improve these smoking kilns is necessary in order to minimize losses due to chemical changes and microbial activities. As such, this will enhance the shelf-life and increase consumers' preference. The fact that microbes of bacteria and fungi origins were identified from the all the processed fish supported the fact there are so many incidents of fish spoilage across the world, particularly in the tropics, which facilitate microbial activities and chemical changes, with a resultant deterioration and spoilage (Onyia et al., 2011). Haruna (2003) reports that fish is a low-acid food that supports the growth of pathogens if not carefully handled and rapidly processed after harvesting. Meanwhile, it is important to note that real food poisoning emanates from moulds. This fact is supported by the Encyclopedia of Food Science and Technology (1992) that the possible production of Mycotoxin from fungi such as *Aspergillus flavus* and *A. parasiticus* tends to be carcinogenic and thus are of concern to regulatory agencies. The occurrences of the same bacteria and fungi on the fish samples are indications of being contaminated at one point. Ugwumba (1992) states that the changes are characterized by a series of biochemical changes such as glycolysis caused by enzyme action, rigor mortising the muscle (stiffening of muscle), muscle tendering by post-rigor, autolysis caused by the action of proteinases (muscle protein enzymes) and finally, spoilage due to microbial action and release of mucus. A large amount of fish is lost after harvesting with respect to quality and quantity which is due to hot weather, low levels of post-harvest technologies and poor handling methods (Ugwumba, 1992).

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

The topic title "Nutrients And Microbial Assessment Of Smoke-Dried Fish in Two Major Markets in Kano State, Nigeria" aim at examining the nutrients and microbial load on smoked and sun dried fish, the efficiency and problems associated with smoked fish. The research is restricted to the study of *Clarias gariepinus* and *Tilapia zilli*, in two major markets in Kano state. The study was conducted in Kano State; where fresh water fishes have a very old history due to availability of numerous fresh water bodies in the State. The State lies on Latitude 10°33'N to 12°37'N and Longitude 7°40'E to 9°29'E. It is within the Sudan-Savannah zone; the total land area of the State is 20,709 square kilometer. The mean daily maximum and minimum temperature are 91.6°F (33.1°C) and 60.6°F (15.85°C) respectively. Kano State is boarded to the north and northwest by Katsina State, to the east and northeast by Jigawa State, to the south by Bauchi State. It lies to the southwest of Kaduna State). Agriculture is the major employment of labor in the State with many citizens involved in farming, fishing and marketing of aquatic resources such as fish, frog either dried or smoked or fish by-products. The materials used for the research were Aluminum plastic dishes, Oven, Desecrator, and Measuring scale/weighing balance, Blender. Data analysis using, Duncan (1955), and multiply range test was used to determine the significant of the mean differences. Data collected from each parameter was subjected to computation of variance tool for analysis ((ANOVA).

5.2 Conclusion

The results shows that the smoke fish have high nutrient contents compare to dry one.

5.3 Recommendation

Government should enact law that would imposed standardization of fish smoking in the country. Government should provide modern equipment for smoking of fish to the business men and women. Awareness campaign should be created to the farmers in respect of fish smoking

REFERENCES

- Abdullahi (2001). Changes in nutritional content in smoked fish during storage. *Food Chem.* 32: 193-300pp
- Adebayo, (2008). Nutritional Content in dried fish during storage. *Food Chem.* 32: 193-300pp
- Adeboye, (2003). Food Analysis and Instrumentation practice Support Nig. Ltd Adeniyo Jones Lagos Nigeriapp52-150.
- Al-Jedah, (1999). Micro Safety and Shelf life of smoked blue catfish (*Ictalurusfurcatus*). M.sc.Thesis 48-93 pp
- Adekoya and miller (2004). Fish cage culture potential in Nigeria-an over view. National culture. *Agriculture focus* 1(5):10
- Amiengheme., (2005). Fisheries production and Rural Development in Nigeria *Journal for fishes* Vol. 8 pp44
- AOAC (1990). Food composition data, production management and use, effect of protein and energy supplementation on a citu disappearance for dry and fresh organic matter
- Anon, (2000).Communication from the Commission to the council and the Parliament. Con (2000).724, Brussade European Commission, 20pp
- Aref., (1965). Mechanism of binding of chunks of meat, fish.
- Azeza., (1980). Advances in food and nutrition.
- Bene, C; and S. Heck (2005).Fish and Food Security in Africa. NAGA, World fish center Quarterly Vol.28 No. 3-4. July-December, 2005.
- clucer and sutchitte (1981). UNICEF (2006) and (Ligia 2002). (Bene and Heck 2005),.Effect of Spice treatment on the quality of hot- smoked mackerel (*Scomberscombrus*).Presented tat the Seventh FAO Expert Consultation in Africa, Senegal. 2001. 1-10pp
- Duncan, D.B. (1955). Multiple ranges and Multiple F-Tests. *Biometrics* 11: 1-42.
- Encyclopedia of food science and technology (1992)
- Eyo A. A. (1977). Significant of fish handling, preservation and processing in the development of nigeria inland fishery with special reference to kainji lake.
- Eyo A. A. (1991). Comparative Study of the Quality of smoked fish from four different smoking kilns. Proceedings of the FAO Expert Consultation on fish Technology in Africa: Accra, Ghana, 22-25 October, 1991.
- Eyo A.A (1992). Aflatoxin in smoked dried fish.Fish processing technology in Nigeria.
- Eyo A. A. (1997). Effect of smoke drying on the proximity composition of tilapia zilli, and parachannaobscura and clariasgaripinus obtain from akureondo state, Nigeria.
- Eyo A. A. (2001). *Fish Processing Technology in the Tropics*. National Institute of Fisheries, Fresh Water Research New BussaPp 402
- Ezeri et al., (2009).Biology of Beetle Pests of smoked fish in Nigeria, University of Ibadan Nigeria.
- FAO (1981).Food loss prevention in perishable crops.Food and agriculture organization of the united nation.
- FAO (2000).statistical year book of the food and agricultural organization.Domestic food price volatility by level of economic development.
- FAO, (2001).Food and Agriculture Organization Data 2004.<http://faostat.fao.org/faostat/collections>
- FAO, (2003).Food and Agriculture Organization Data 2004.<http://faostat.fao.org/faostat/collections>
- FDF (1997).Fisheries statistics.
- Food And Agricultural Organization (2006), Food Analysis and Instrumentation practice Support Nig. Ltd Adeniyo Jones Lagos Nigeriapp52-150.

- Haruna, (2003). Hazard Analysis Critical Control Point (HACCP) Micro Safety and Shelf life of smoked blue catfish (*Ictalurusfurcatus*). M.sc.Thesis 48-93 pp
- Huisman (1987), Biological studies of Beetle Pests of dried fish in Nigeria with special reference to *Dermestesmaculatus*Deg.And*Necrobilarufipes*Deg.Ph.D.Thesis, University of Ibadan Nigeria.
- Ikeme A. I and C.S. Bhandary (2001).Effect of Spice treatment on the quality of hot- smoked mackerel (*Scomberscombrus*).Presented tat the Seventh FAO Expert Consultation in Africa, Senegal. 2001. 1-10pp
- Igene (1983). Nutritional and microbial evaluation of fresh, solar,smoked and fry dried siganus (Rabbit) fish species of Kenyan marine coast.
- Keller (1990).Consumer perception of brand extention.
- Ligia, V.A.S. (2002): Hazard Analysis Critical Control Point (HACCP) Micro Safety and Shelf life of smoked blue catfish (*Ictalurusfurcatus*). M.sc.Thesis 48-93 pp
- Luna, J. (1983). Impact of fisheries on Rural Development Vol. 8 pp1.
- Luna (1983).guiding agricultural policies
- Madison et al (1998). Electronic tagging and tracking in marine fisheries, proceeding of fish.
- Mcfarland (1982).Advances in solar energy.An annual review research and development.
- Moyle, P,B.and J.J Cech (1982) changes in fish diet and mercury accumulation in water.
- National academy press (1988).biodiversity and life study, commission of life science.
- NAS (1988).Uncertainties in cancer coefficient for environmental exposure to radionuclides.
- Ouwuka (2005). Food analysis and instrumentation
- Olakore et al (1997). Millennium ecosystem assessment.
- Onyia et al (2011). Evaluation of microbial loads in smoked and sun-dried fish in major market in yola, adamawa state.
- Onyia (1989).Utilization of waste water in fish production. Preliminary from fish culture studies in floating cages in a sewage pond
- Onwuka, (2005). Food Analysis and Instrumentation Theory and practice Division of H.G Support Nig. Ltd Adeniyo Jones Lagos Nigeriapp52-150.
- Osuji, F.N.C. (1973). Studies on the Biology of Beetle Pests of dried fish in Nigeria with special reference to *Dermestesmaculatus*Deg. And *Necrobilarufipes*Deg.Ph.D.Thesis, University of Ibadan Nigeria.
- Pike, (1989).UNICEF (2006) and (Ligia 2002). (Bene and Heck 2005),.Effect of fish treatment on the quality of dried mackerel (*Scomberscombrus*).Presented tat the Seventh FAO Expert Consultation in Africa, Senegal. 2001. 1-10pp
- Poulter et al (1989). Production and processing of healthy meat, poultry and fish product.
- Ruiter (1995).Fish and fisheries production. Composition and nutritive properties
- Sadiku and Oladimeji (1991).Communication from the Commission to the council and the Parliament.Con (2000).724, Brussade European Commission, 20pp.
- Salman Gairdnemin (Reintzet al., 1979), Europeeel *Anguila* (Deganet al. 1986), American eel, *A. roustrata*
- Simko, P. (1991); Changes of BenzoPyrene content in smoked fish during storage.*Food Chem.* 40: 293-300pp
- Ugwumba (1992). Microbial loads analysis of fresh mound catfish
- Ward, (1995).Comparative Study of the Quality of smoked fish from four different smoking kilns. Proceedings of the FAO Expert Consultation on fish Technology in Africa: Accra, Ghana, 22-25 October, 1991.
- Wheatson and lawson (1987). Top down bottom up diffusion experiment in a water conversion tank.
- World UNICEF (2006).Fish Processing Technology in the Tropics.National Institute of Fisheries, Fresh Water Research New BussaPp 8-20.