

A Survey of the Methods of Fish Processing and Preservation Employed By Artisanal Fishermen in Kaduna City

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Abstract

Difference methods used in processing and preservation of fish by artisanal fishermen in Kaduna city were studied. The methods of processing include washing, clearing, curing, drying and smoking while preservation involved different types of traditional ovens and freezing. Both men and women were involved in processing and the best method of fish preservation was freezing. The level of literacy and age of the fish processors were related to the preservation methods adopted.

Keywords: Fish, processing, preservation, artisanal fishermen and Kaduna city

Introduction

Artisanal fishing in Africa, historically dominated by fishermen in canoes and boats has provided fish as a nutritious source of food of high quality protein often cheaper than meat. Fish consumption is not forbidden within religious groups unlike eating Dog and pork (which is forbidden in some religion (Agbelege and Ipinjolu 2001). As a result fish has been consumed by large proportion of the population and has become a staple diet. With the rising cost of meat and cheese protein foods, consumers have become increasingly interested in fish as a source of dietary protein. Fish are consumed as food all over the world. In many countries of Africa, the average diet contains less protein. Fish is the cheapest source of animal protein (Jamin and Ayinla, 2003). With increase in human population in Nigeria, less fish will be available per caput annually (Eyo, 1999).

Fish is highly susceptible to deterioration without any preservative or processing measures (Okonta and Ekelemu, 2005). Due to its chemical composition, fish is a perishable food material and its flavor and texture changes rapidly during storage after death. Fish harvesting, handling, processing and distribution provides livelihood for millions of people as well as providing foreign exchange to many countries (Al-Jufaili and Opara, 2006). In many rural fishing communities, the infrastructures for post harvest processing and preservation of fish is inadequate. As a result losses reach up to 40% of the total catch by weight (FAO, 1981). The fishing industry despite its importance suffers from enormous post harvest losses which are estimated at 35-40% of landed weight (FAO, 1981). (FAO, 1994) estimated that post harvest losses remain about 25% of the total world catch annually. These losses have a profound adverse impact on fishing communities whose status and income often depend on post harvest activities. Such losses also have a detrimental impact on the socio-economic life of the fishing communities and reduce the amount of animal protein available to large segment of the population.

The current demand for fish food is estimated at a little over 1 million tones/annum as against a supply of 800,000 tones per annum (West, 1982). Despite the subsistence of our nature of capture, fisheries in Nigeria as much as 50% of post-harvest losses are recorded (Bolorunduro, 1996). A lot of fish is imported into Nigeria to reduce this shortfall (Ndok, 1982). Nigeria has therefore invested much in fish production, processing and preservation in order to meet the domestic need of her people and for international market (Jamin and Ayinla, 2003). This therefore aims at studying the various methods of fish processing and preservation employed by artisanal fishermen in Kaduna city.

Materials and Methods

Data on the various methods of fish processing and preservation employed by fishermen in Kaduna city was obtained through interviews conducted on the fishermen as well as through visits, surveys and studies carried out and observation made on the fish processing methods and the fish processors.

Fish bruise easily and so should be handled carefully. Processing, preservation and storage methods include smoking, sun drying, salting, frying or a combination of these (Clucas, 1982). The processing sequence starts from grading the fish by species and size. The fish was sorted out manually by species as well as on the basis of physical damage. The fish was washed primarily to clean the fish and remove accumulated bacteria as well as removing accumulated slime on the surface of the body. The fish species were scaled manually. Tools for scaling such as table knife were moved over the body of the fish from tail fin towards the head pulling out the scales. Also the fins were cut away with a knife. Sometimes the head of the fish was cut off as an inedible part (Kraseman, 2005).

Gutting was done in order to remove those fish body parts most likely to reduce product quality as well as the gonads and sometimes the swim bladder. Gutting was carried out by cutting open the belly and removing the internal organs. The body cavity was cleaned of the peritoneum, kidney tissue and blood. The fish was cut

longitudinally up to the anal opening on a table which is hard, easy to wash and does not absorb fluids. Sometimes protective gloves which could be replaced was worn during gutting. After processing fish was curled round so that the tail reaches the head and both body parts were held together using a pointed stick (Eyo, 2001). Also after processing the fish was preserved using the following methods:

- a. Fresh fish was washed clean and placed in containers or coolers and covered with ice blocks.
- b. The fish was dipped into brine (a mixture of $\frac{1}{4}$ cup of salt to 1 quarter of cold water) for 20 secs.
- c. Freezing: the fish were put in small packages or air tight vapour proof packages such as aluminum foil and put in deep freezer at a freezing temperature of 0°C.
- d. Drying: the fish were placed in a smoke house hanger or racks wiped with vegetable oil and allowed to dry for about 1 hour. A shiny-like layer formed on the fish surface seals the surface and prevent loss of natural juices during smoking. Sun drying of the smaller fishes are done directly under the scotching sun. The fish are either sun dried whole or split open ventrally and laid on mats to dry (Welcomme, 1998).
- e. Smoking: during smoking in the smoke house all combustible materials around and under the smoking area were cleared. A small bed was formed of coal and fire made and the coals covered with damped hardwood chips to avoid flaming. The fish were laid on the wire gauze in the oven and fired from below and were smoked for about 4-5days.
- f. Storage: when smoking was completed, the fish were removed and allowed to cool. Later they were stored in containers where they are protected from dust and insects.

Result

The result of the investigation showed that initially broad leaves were used to cover catches in order to cool the fish and delay deterioration. Various steps or methods involved in the processing of the fish included cleaning, curing, drying, smoking and storage.

The bruised fish was placed on ice or deep freezer immediately. Preliminary processing of the fishes consisted of evisceration, cutting of the fins and slicing of whole fish in to steak (plate 1). This type of Processing was performed by both men and women (plate 2). Sorting of the fish by species on on the basis of freshness and physical damage was done manually. The result also reveals that after washing and cleaning the fish were bent and the head and tail held were joined together with pointed sticks while some others were cut in to serving pieces. Women played a prominent role in the post-harvest activities. They participated most actively in holding the heads and tails of the fishes together with sticks, (plate 2). The different fish species were seen to require different preparation techniques. For those with scales, the scales were first removed before smoking the fish were placed on gauzes kept on open pits containing smoldering woods. (Plate 3). In some cases fish were laid in mud ovens (plate 4) or cut drums with racks inside and left in the air to cool (plate 5) or alternatively placed on racks supported by iron poles (plate 6) on which fish was laid. The fish were also stored in deep freezers (plate 7) if they were not processed for smoking or sometimes put in small packages or in air tight vapour proof packages such as aluminium foil before they were put in freezers. They were sometimes spread on tables (plate 8) or packaged baskets or cartons.

Out of fifty 50 fish processors interviewed, eighteen (36%) were literate while thirty two (64%) illiterate (table 1). Thirteen (72.2%) of the eighteen literate ones and seven (21.8%) of the illiterate ones employed the modern freezing method of preservation (table 2). Table 2 also showed that fish processors between the ages of 21-50 years employed the modern freezing method of preservation.

Discussion

Fish is a very perishable food commodity that requires proper handling and preservation to increase its shelf-life, quality and nutritional value (Ye, 1999). Fish were washed to remove slime that accumulated on the skin which creates perfect environment for micro-organisms growth. Therefore fresh water fish processing should assure health safety of products as well as best possible market quality.

The fish were sliced into steaks and gutted. Bonnet (1994) recommended that to reduce bacterial processes immediately on dead fish, it should be beheaded, gutted, washed and chilled to inhibit unfavourable enzymatic and microbial processes. The fish were smoked on different types of traditional ovens, round mud and kilns of different types or cut drum ovens with low batch capacities and long drying times. Akinola *et al*, 2006 reported different types of preservation methods; such as drying, smoking, freezing, chilling and brining. Although Akinola *et al* 2006 reported that despite the rudimentary nature of process of traditional methods, lack of control of over-drying rate sometimes result to over-drying or under-drying, exposure of the fish to dust, dirt, insects infestation and contaminant such as flies, yet this method still remains predominant in Nigeria. Smoking is one of oldest and most common methods used for fish preservation in the Chad basin (Ahmed and Agbelege, 2007). Processing methods generally in practice in Nigeria are traditional and consist of sun drying, salted and sun drying, smoke drying (Tobor, 1984).

Traditional fish preservation methods have been practiced for centuries (Ayinla and Okomoda, 1997) Neiland (1991) reported that traditional fish processing methods including smoking, char burning and sun-drying and post harvest losses persist in Lake Chad. Krase-man (2005) has reported that people from all cultures in the world over have relied on the smoke curing of fish and meat production for long term storage. Women were observed to be involved in fish processing in Kaduna. FAO (1981) reported that in west Africa, women play prominent role in most post harvest of fish activities which includes sorting and size grading that are important for fish processing and marketing. Ayinla and okomoda (1997) reported that majority of processors in the central zone of Nigeria were females, although Anon (1971) had reported that the health of women smokers were at risk.

Fish were place in open pits containing smoldering wood. Although traditional ovens and kilns produce fish of uneven quality and often pose work-related health risk due to lack of control over temperature and smoke density (Adelowo et al, 1999, Clucas, 1982) mud ovens were most commonly used probably because they are cheap to build, and all materials used in their construction came from local sources. Despite the health risk of smoke and the dull and unattractive colour of smoked fish (Eyo, 1985), Kraseman (2005) reported that wood smoke produce microscopic particles which rise as frogs or vapour and these vapours contain volatile oils which are released from the wood and furnish the characteristics textures, flavours and preservative qualities. Also Okoko (1996) reported that smoke drying is employed by remote fishing communities due to traditional preference of the local people for smoke dried fish and lack of sophisticated preservation techniques. Lydia (19777) reported smoking deposits a coating of antimicrobial material or substance on the surface of the fish while at the same time impacting an attractive sheen and pleasant taste which is cherished by the lacol populace. UNIFEM (1988) reported that generally smoking of fish was very common in Africa.

The use of freezers to preserve fish was not very common and was employed mostly by literate fish processors. This could perhaps be a way to avoid the health and fire risk involved in smoking as well as to avoid air pollution from charring of fish or because of their ability to purchase a freezer. Freezing methods of preservation of fish employed techniques based on temperature as is obtained in the refrigeration and freezing. Stirling (1985) reported that this preservation prevents the growth of bacteria, fungi and micro-organisms as well as retarding fat oxidation which causes rancidity. Jamin and Ayinla (2003) reported that spoilage of fish is slowed down at freezing temperatures, while Adams and Moss (1999) reported that the rate of most chemical reaction are temperature dependent and so the temperature is lowered, the rate of chemical reaction decreases.

Fish processing operations produce wastes in both solid (carcasses, viscera) and liquid (waste water, blood) forms. They must be disposed of in a manner that should not contaminate the processing environment or be detrimental to the receiving environment (lashen, 2000). Fish are not uniformly smoked but case- hardened and most times if left in the sun to dry completely blowflies lay eggs on the fish which develop into maggots, penetrate the partially dried flesh causing serious harvest loss and low market value (Eyo, (2001).

Due to inadequate infrastructure for post harvest processing and preservation among fish processors in Kaduna, a certain percentage of the fishermen's total catch by weight is lost. ECA (1984) reported that there is much observed evidence of loss at every stage from harvest to consumption. These losses have direct impact on the nutrition of millions of people. If not sold fresh, preservative methods such as freezing should be applied to extend the shelf life to the fish and full health safety of the fish products.

Conclusion

Since fish and fish products are perishable without any preservative and processing measures, it is imperative and essential to process and preserve fish in order to assure health safety of the product and reduce water to the bearest minimum as much as possible.

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References

- Adams, M R and Moses, M O (1985) Food Microbiology Royal Academy of Chemistry, Science Park, Cambridge p398
- Adelowo, E O, Okomoda, J K, Mdailbli, M and Eyo, A A (1997)improved smoking kiln on lake Kaiji, A report submitted to the Nigerian-German Kainjilake promotion project. New Bussa
- Agbelege O O and J K Ipinjolu 92001) An Assessment of the Exploitation and Management Techniques of the Fisheries Resources in the Nigeria portion of the Lake Chad, *Journal of Arid Zone fisheris Vol.I 89-98*
- Ahmed T M and OO Agbelege (2007) An Appraisal of the Traditional Fish Handling and Processing Methods in Lake Chad, proceeding of the Fisheris Society of Nigeri, 22nd Annual Conference Kebbi 46-51

- Akinola, O A., Akinyemi, A A. and Bolaji, B O. (2006) Evaluation of Traditional and solar drying system towards enhancing fish storage and preservation in Nigeria (Abeokuta Local Government as a case study). *Journal of fisheries international* 1(2-4): 44-49.
- Al-Jufaili, M S, and Opara, L U., (2006) Status of fisheries post-harvest industry in the Sultanate of Oman: Part 1. Handling and marketing system of fresh fish. *Journal of fisheries international* 1 (2-4): 44-49b.
- Anon (1971) Equipment and Methods for Improved Smoke drying in the Tropics, FAO Fish Technology pap No. 104
- Ben-Yawuri M (1991) A Practice guide, Improved Fish Smoking in West Africa, proc. Fish Dev. Exp. Training Course, Uyo Akwa Ibom State 137-217
- Bolorunduro P., (1996). Livestock and fish production technology for Women in Agriculture, la proceedings of National trading workshop held at N A E R I pp 65-68
- Bonell A D (1994) Quality Assurance Seafood processing, A Practical guide, Chapman and Hall, New York p 331
- Clucas J I (1982) Fish Handling, Preservation and Processing in the Tropics, part 2 Report of the tropical Development and Research Institute G. 145 p. 18
- ECA (1984) Women in the Artisanal Fishing Industry in Senegal and Ghana, African Trainig and Research Centre for Women, E/ECAA/ATRCW/84/04
- Eyo E A (1985) Evaluation of Colour and Flavour of Tilapia Smoked with Different Wood types Trop. Sc. 25. 265-270
- Eyo A A (1991) Fish Processing and Marketing in the Arid Zone of Nigeria with particular Reference to the Lake Chad area, in lake Chad and Arid Zone Fisheries A A olatunde and J S O Ayeni (des) National Institute for fresh water Fisheries New Bussa, Nigeriapp 172-175
- Eyo A A (2001) Fish Processsing Technology in the Tropic, University of Ilorin press 403p
- F.A.O (1981) The Prevention of losses in cured Fish FAO Fish Tech. papers, No219. 89p
- FAO, (1994) Review of the State of World marine Fisheries Resources, FAD Fish Technology papers 335p
- Huss H H (1995) Quality and Quality Changes in Fresh Fish Tech. paper 348 FAD Rome
- Jamin D M amd Ayinla A O (2003) Potential for the Development of Aquaculture in Africa Naga: vol.26 (3) 7-13
- Kraseman S (1963) Fish Smoking, A Torry-kiln Operattyors handbook, Torry research Station Department of Science and Industrial Research Min. of Technology Edinburgh
- Lahsen A T (2000) Processing fish and fish Products, Fisheries and Aquaculture 3rd ed. Vol. 1, 150-200
- Lydia C M (1997) So easy to Preserve, 3rd Edition Co-operative Extensive Service, the University of Georgia College of Agriculture p 265
- Neiland A E (1991)An Overview of Fisheries Research in the Chad Basin of Africa 1920-1988 Including a Partially annotated bibliography, CMARE Res pap. No 45 (IV) 79p
- Ndok O J (1982) Proceeding of the 2nd Annual Conference of the Fisheries Society of Nigeria Calabar 25-27 Jan. 1982
- Okoko A C (1996) Chorkor Stove for Fish Smoking Material and Construction in Proceedings of the Refresher Training course for Fisheries 24th Oct. Uyo Akwa Ibom State, Nigeria 96-100
- Okonta, A A. and Ekelemu J K., (2005). A preliminary study of Micro- Organisms associated with fish spoilage in Asaba, Southern Nigeria. Proceedings of the 20th Annual conference of fisheries society of Nigeria (FISON), Port-Harcourt 14th-18th November, 2005-557-560 pp
- Stirling H P (1985) Chemical and Biological Methods of Water Analysis for Aqua culturists, Institute of Aquaculture, University of Stirling, 107-109
- Tobor J G (1984) A Review of the Fishing Industry in Nigeria and status of Fish Preservation Methods and the Future growth Prerequisites to cope with Anticipated Increase in production, NIOMR Tec. Pap. No. 17
- Tobor J (1990) Fishing Industry in Nigeria Status and potentials for self Sufficiency in Production. NIOMR Technical paper No. 54 p 5
- Welcomme R L (1985) River Fisheries, FAD 1985 Tech. pap. (262):330p
- West W Q B (1989) African Inland water Fisheries and the Environment, in proceeding of the National Conference on two decades of Research on Lake Kainji ed. Ayeni, JSO & olatunde AA 29th Nov-1st Dec 1989 p 58
- Ye Y (1999) Historical Consumption and Future demand for fish and Fishery products, Exploration Calculations for the Years 2015, 2030. FAO Fisheries Circular No 949 Rome
- UNIFEM 1988) Fish processing, Food Cycle Technology, Source Book No 4 p 31



Plate 1: PRESERVATION METHOD: Fresh Fish being smoked on a Metal gauze with fire supplied by firewood under the gauze



Plate 2: PRESERVATION METHOD: Fish already dried being exposed to cool



Plate 3, PRESERVATION METHOD: Tukuba (Hausa Name) Fish on a gauze, on top of the block wall with fire supplied under the gauze



Plate 4, PRESERVATION METHOD: Burning firewood inside the smoke house first before the Fish is smoked



Plate 5, FISH PROCESSING:
Fishermen removing scales from fresh-water fish



Plate 6, FISH PROCESSING: Women
putting-in sticks into fish before drying



Plate 7, FISH PRESERVATION:
Freezing of Fish in a deep freezer



Plate 8, FISH PRESERVATION: fresh
fish being smoked on fire from charcoal
in a metal drum

TABLE: AGE LEVEL AND ADOPTATION OF PRESERVATION METHODS AMONG FISH PROCESSORS

FISH PROCESSORS USING DIFFERENT SMOKING METHODS

		NO USING FREEZING METHOD		LONGITUDINALLY DIVIDED OVEN *(MURFU)		HORIZONTAL DIVIDED OVEN *(MURFU)		SMOKING OVEN *(TUKUBA) WITH BLOCK WALL		SMOKING OVEN *(TUKUBA) WITH CLAY WALL	
AGE LEVEL IN YEARS	TOTAL NO OF FISH PROCESSORS	NO OF FISH PROCESSORS	%NO OF FISH PROCESSORS	NO OF FISH PROCESSORS	%NO OF FISH PROCESSORS	NO OF FISH PROCESSORS	%NO OF FISH PROCESSORS	NO OF FISH PROCESSORS	%NO OF FISH PROCESSORS	NO OF FISH PROCESSORS	%NO OF FISH PROCESSORS
21-30	6	1	16.7	-	-	3	50	1	16.7	1	16.7
31-40	16	4	25	3	18.8	3	18.8	4	25	2	12.5
41-50	13	8	16.5	2	15.4	1	17.7	2	15.4	-	-
51-60	8	4	44.4	-	-	2	22.2	-	-	2	22.2
61-70	7	1	16.7	1	16.7	-	-	1	16.7	4	66.7
TOTAL	50	18		6		9		8		9	

*LOCAL NAME

TABLE 2: LITERACY LEVEL AND ADOPTON OF FISH PRESERVATION METHODS AMONG FISH PROCESSORS

LITERACY LEVEL	NUMBER OF FISH PROCESSORS	NO. OF FISH PROCESSORS USING MODERN (FREEZING METHODS)	% OF FISH PROCESSORS USING MODERN METHOD	NO. OF FISH PROCESSORS USING PRIMITIVE METHOD (SMOKING METHOD)	% OF FISH PROCESSORS USING PRIMITIVE METHOD (SMOKING METHOD)
LITERATE	18	13	72.2	5	27.8
ILLITERATE	32	7	21.9	25	78.1
TOTAL	50	20	40	30	60

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