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Fish Processing Technologies in Nigeria: A Case Study of Ibeju-Lekki Local Government Area, Lagos State

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ABSTRACT

Traditional fish processing technologies vary widely in terms of equipment type, size and processing efficiency in Nigeria's coastal states. This study was carried out to identify fish processing technologies and evaluate the effectiveness, energy sources and efficiency of fish smoking equipment used in the study area. Data was collected using structured questionnaire administered between January and March, 2011 in seven fishing villages along the coastline in the Ibeju-Lekki LGA, Nigeria. Major fish species being processed were identified and the profitability of the post harvest technologies adopted was evaluated. A total of five traditional fish processing equipment were observed and included galvanized iron sheet supported by planks 51 (46.4%), drum oven 8 (7.2%), black clay oven 24 (21.8%), red clay oven 9 (8.1%), brick kiln 5 (4.2%) and government model kiln 4 (3.5%). Generally, energy sources were fuel wood and charcoal for traditional fish processing equipment and electricity for the government model kiln. Majority of traditional fish processors were peasant women and three types of processing technologies were observed, including air drying (1.0%), hot smoking (69.1%) and salting and smoking (29.9%). The capacity of kilns and ovens observed ranged from 20-50 kg day^{-1} with a price range of ₦10, 000-₦50, 000. Factors considered before replacement of smoking equipment by the processors were equipment ruggedness, cost and production capacity. Women's involvement in traditional fish processing was 95% and major fish species in the value chain included *Ethmalosa fimbriata*, *Caranx senegallus*, *Sardinella maderensis*, *Drepane africana*, *Cynoglossus monodis*, *Pseudotolithus senegalensis*, *P. typus*, *Arius latiscutatus* and *A. mercatoris*. It was observed that products of traditional fish processing industry were readily acceptable to consumers and commanded marginal market prices with optimal economic benefits to processors.

Key words: Fish value chain, Nigerian coastline, processors, women, traditional fish processing equipment

INTRODUCTION

Fish processing is the processes associated with fish and fish products between the time in which fish are caught or harvested and the time in which the final product is delivered to the customer. The processing and preservation of fish were of utmost importance since fish is highly susceptible to deterioration immediately after harvest and to prevent economic losses (Okonta and Ekelemu, 2005). If fish is not sold fresh, preservation methods should be applied to extend its shelf-life. These

include freezing, smoking, drying and heat treatment (Sterilization, pasteurization, etc). Efficient preparation of fish is important when top quality, maximum yield and highest possible profits are to be achieved (Davies and Davies, 2009). According to Davies *et al.* (2008), the processed fishery products were still stored using traditional processing and storage technologies, respectively. Lack of adequate fish handling, processing techniques and storage facilities contribute significantly to the low supply of fish to poor rural dwellers that form three quarters of the population in developing countries (Ayuba and Omeji, 2006). The long distance of distribution necessitates some processing and storage since preservation through refrigeration is not readily available (Agbon *et al.*, 2002). Ayuba and Omeji (2006) reported that insect infestation is the cause of most prominent losses in quality and quantity of stored, dried fish in Nigeria. The need for the development of fish preservation and processing machinery and techniques for effective fish handling, harvesting, processing and storage can never be over-emphasized especially now that aquaculture production is on the increase in Nigeria (Davies *et al.*, 2008). With continuing growth in population, income and urbanization in Nigeria, consumer theory assures the future demand for good quality fish and other animal products (FAO, 2002). According to Horner (1992), storage life extension of smoked fish can result from a combination of lowered water activity and the uptake by the product of bactericidal and antioxidant components of wood smoke.

With improved technologies, fresh fish can be processed as wanted without any significant loss of quality. According to Hilderbrand (2001), the most important factor in the profitability of smoked fish production (aside from selling price) is the yield of finished product. This is because, raw material costs represent the largest percentage of total costs. Producers should understand how smoking procedures affect the interrelationships between yield, throughput and final profitability. Presently in Nigeria, the mechanization level of fish processing is low which results from the overall limited production, seasonal availability of fish, poor information dissemination of the available improved technology to processors and lack of inexpensive equipment adaptable for processing (Davies and Davies, 2009). The production system is mainly artisanal and fish are marketed mostly in five different forms; fresh, smoked, dried, salted and frozen (FAO, 1996). Processing of fish either through smoking or drying are widely used in fish preservation in the process, moisture content present in the fish is extracted through heating, thus inhibiting the action of micro - organisms and prolong shell life (Clucas and Ward, 1996; Oyeleye, 2003; Amoo *et al.*, 2007). Many fish species have very good preservation qualities after salting, sun drying and even smoking (Madu *et al.*, 1984). Eves and Brow (1993) reported that the processing of fish by smoking or drying enhances the nutritive value and promotes digestibility of protein. Reilly *et al.* (1998) reported that food quality and safety associated with aquaculture products will differ from region to region and habitat to habitat and will vary according to the method of production and harvesting process. Some of the traditional fish processing methods are associated with contamination which may be injurious to consumers. While, Davies (2005) suggested the adoption of appropriate processing technologies that give satisfaction to consumers and equally preserve economical balance. Eyo (1997) reported the high level of post harvest losses in Kainji lake Basin, revealing that about 12% of fish is lost post-harvest in the fresh state. For dried fish, 16% is lost before and during processing and 6% from storage prior to sales, bringing the total loss of fish to 35% in the lake. Eyo (1997) further reported a loss of 1000 metric tonnes of fish in Kainji Lake, estimated at about 80 million Naira in 1995. According to Davies and Davies (2009), the problem of high post-harvest losses has been recognized as a major impediment to the realization of the goal of increasing the contribution of fisheries to the Nigerian economy. There is a dearth of information on the exact

magnitude of post-harvest losses in fisheries. Such information would be valuable in developing appropriate technologies and intervention to mitigate the post-harvest fish losses. Eyo (1992) reported different types of preserving methods including drying, smoking, freezing, chilling and brining. The prominent fish preservation method in Ibeju-Lekki, southwest Nigeria is smoke-drying, because not all fishing communities along the coastline have asses to electricity to preserve their catch.

Olokor (1997) analyzed the various advantages of adopting solar energy as a means of drying fish traditionally. Akinola *et al.* (2006) also reported different types of fish preservation and processing methods. It has been observed that the most prominent fish preservation method in Nigeria is smoke drying. This could be as a result of the fact that most of the coastal communities have no access to electricity to preserve and or process their products. Bolaji (2005) reported that despite the rudimentary nature of traditional processing methods, the lack of control over the drying rate, sometimes results to under- or over-drying and expose fish to wind, dust, dirt, insect infestation and contaminants such as flies. These methods still remain predominant in Nigeria.

Tawari (2006) and Davies and Davies (2009) also reported that most of the fish processing communities in Nigeria employed traditional techniques that have been in existence for many years. In order to reduce post harvest losses and improve fish product quality, traditional processing technology must be improved by upgrading traditional fish processing technologies, especially by developing increased control over the production processes. Most available modern drying technologies are expensive and not appropriate for developing countries where prerequisites for these technologies, such as electricity are not available.

Therefore, this study was focused on documenting fish processing technologies in the study area, identifying the types of smoking equipments available, their fuel- efficiency and the energy sources in use, while also assessing the fish species being processed and the socio-economics of participants in the value chain.

MATERIALS AND METHODS

The study area situated in Ibeju-Lekki, Lagos State as shown in Fig. 1.

Fig. 1: Gender and age distribution of fish processors in Ibeju-Lekki LGA, Nigeria

Data collection: Structured questionnaire, semi-structured interview and field observation were used to assess the existing fish processing techniques. The fishing communities under the study were sampled between January and March 2011 and included Eleko, Iberekodo, Magbon-Alade, Orimedu, Akodo, Osoroko and Okun-Ise. An average of 13 questionnaires was administered in each community and a total of 97 processing centers was visited. Parameters investigated by the questionnaire included the fish processing technology, fish processing equipment, the fuel-efficiency of energy source, including the identification of the species processed.

Statictical analysis: The data obtained was subjected to qualitative statistical analysis using Standard Deviation of the Average (SAV) and Statistical Package for Social Sciences (SPSS) evaluation.

RESULTS AND DISCUSSION

Age distribution and gender of fish processors in the study area are presented on Table 1. In Table 1, 97.9% of the respondents were women. This is in agreement with Bolorunduro (2003) and FAO (1992), that women were primarily responsible for post harvest activities in the Nigerian fisheries sector. Majority of the processors were between 30 and 49 years of age. Figure 2 shows processing technologies in use in the area.

Three processing technologies were observed to be in use throughout the study area, including; air drying, hot smoking and salting method. Hot smoking was the most widely-adopted processing method at about 69% level, followed by the salting technique (30%) and air drying (1%). All the preparatory processing operations of washing, cutting, degutting, de-scaling, sorting, salting were performed manually. According to the respondents, the traditional smoking technique

Table 1: Gender and age distribution of fish processors in Eti-Osa LGA, Nigeria

Male	Female	Age group	Frequency	(%)	Valid (%)
2	95	20-29	3	3.1	3.2
		30-39	29	29.9	30.5
		40-49	45	45.4	47.4
		50-59	18	18.6	18.9

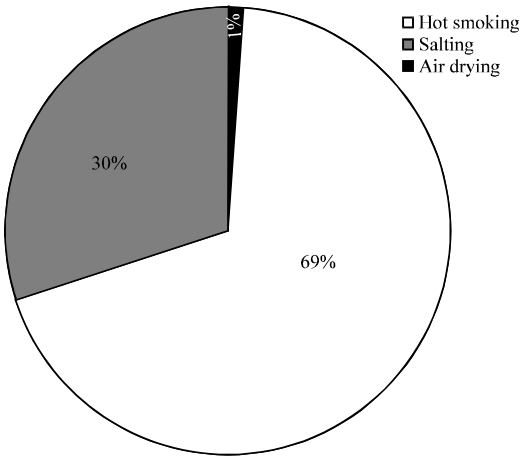

Fig. 2: Processing techniques in use in Ibeju-Lekki LGA, Nigeria

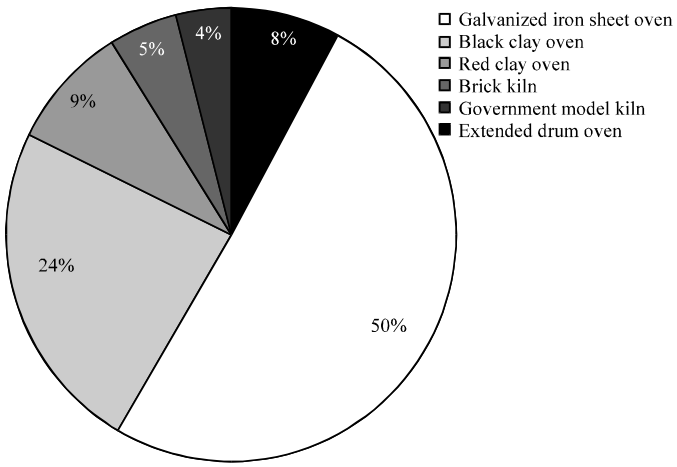

Fig. 3: Fish processing equipment in use in Ibeju-Lekki LGA, Nigeria

Fig. 4: Galvanized iron sheets oven

(hot smoking) had been in existence for more than 40 years, having been passed down from one generation of processors to another. Salt processing method was applicable to selected species of fish while a few species, including bonga fish (*Ethmalosa fimbriata*), rough-head sea cat fish (*Arius latiscutatus*) and butter fish (*Stromateus fiatola*), could not withstand salt processing because of the natural high salt content of their flesh. According to Hilderbrand (2001), neither smoke nor heat by itself is effective in preserving fish.

The statistics of various fish processing equipment observed in the study area is presented in Fig. 3, while some are presented in Fig. 4-6.

Six different processing equipments were observed to be in use in the fishing communities of Ibeju-Lekki area, Eti-Osa LGA Nigeria as presented in Fig. 3. The quantity of fish each processing equipment smoke-dried per batch depended on their various capacities and the number of drying trays available in the equipment. Most of the equipments were locally fabricated, while others were built by the processors themselves. Very few units were provided by the Lagos State Government.

Statistics of available energy sources for powering fish processing equipments in the study area are presented in Fig. 3.

Fig. 5: Circular red clay oven

Fig. 6: Extended drum oven

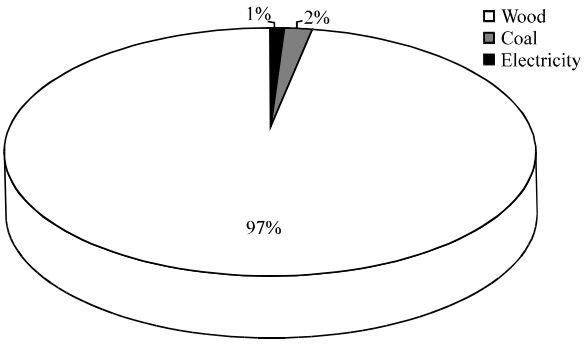

Fig. 7: Energy sources for observed fish smoking equipments

As presented in Fig. 7, the traditional energy sources in the study area were fuel wood, coal and electricity. The percentage level of the application of fuel wood was 97%, while coal and electricity were 2.0 and 1.0%, respectively.

Table 2: Local names of hard wood used for fish smoking in Ibeju-Lekki LGA, Nigeria

Native name	Fishing communities where used
Ikate	Prominent in all the fish processing centers sampled
Akun	Osoroko, Akodo, Magbon-Alade
Ede	Okun-Ise, Orimedu, Eleko and Akodo
Awasa	Orimedu, Iberikodo, Eleko, Akodo and Magbon-Alade
Igi-Awonwon	Akodo, Osoroko and Iberikodo
Igi-Aba	Okun-Ise, Magbon-Alade, Orimedu and Iberikodo
Igi-Agbon (Coconut tree)	Eleko, Iberikodo, Magbon-Alade, Akodo, Osoroko
Padi-Agbon (Coconut husk)	Orimedu, Okun-Ise, Akodo and Osoroko

Source: Field 2011

Table 3: Fish species in the fish processing value chain of Ibeju-Lekki LGA, Nigeria

Species			
Family	Common name	Scientific name	Local name
Carangidae	Senegal jack	*Caranx senegallus*	Alayagangan
	Alexandria's pompano	*Alectis alexandrines*	
Clupeidae	Bonga fish	*Ethmalosa fimbriata*	Agbodo
	Yellowtail sardine	*Sardinella maderensis*	Sawa
Drepanidae	African sickle fish	*Drepane africana*	
Cynoglossidae	Guinea tongue sole	*Cynoglossus monodis*	Abo
Belonidae	Hound needle fish	*Tylosurus crocodiles*	Lamisoro
	Keel tail needle fish	*Platybelone argalus*	Komisona
Hemiramphidae	Ballyhoo half beak	*Hemiramphus brasiliensis*	Lamisoro
Lutjanidae	Gorean snapper	*Lutjanus goreensis*	Opupu
Polynemidae	African thread fin	*Galeoides decadactylus*	Apo
Sciaenidae	Cassava croaker	*Pseudotolithus senegalensis*	Apo
	Longneck croaker	*Pseudotolithus typus*	Kugbe
Ariidae	Marine cat fish	*Arius latiscutatus*	Aro
Paralepididae	Smooth mouth catfish	*Arius mercatoris*	Esun/Kuta
Sparidae	Baraccudas	*Sphyraena afria*	Ejo-Olokun
Ophichthidae	Bogue fish	*Boops boops*	
Liophiidae	Eel fish	*Echelus myrus*	
	Longspine African angler	*Liphiodes kempi*	

Source: Field 2011

The most commonly used fuel wood in the study area was hardwood which varied in nomenclature among fish communities. According to respondents, fish smoke-dried with hard wood possessed the good quality taste, flavor and appearance that conformed to standard market requirements.

Local names of fuel-wood in the 7 fishing communities sampled are presented in Table 2.

Table 2 presents the names of fuel wood being used in the study area. Eyo (1992) reported that the fuel wood contain some acidic chemicals that increase the shelf life of smoked fish. A major challenge identified by respondents was the seasonal availability of hardwood; confirming the prediction that fuel wood scarcity could arise from continued deforestation practices in Nigeria (FAO, 1985).

In Table 3, the major species observed at landing sites in the study area; Bonga (*Ethmalosa fimbriata*), Guinean barracuda (*Sphyraena afra*), Ballyhoo half beak fish

(*Hemiramphus brasiliensis*), Hound needle fish (*Tylosurus crocodilus*), Keel tail needle fish (*Platybelone argalus*), Cassava croaker (*Pseudotolithus senegalensis*), Longneck croaker (*Pseudotolithus typus*), Senegal jack fish (*Caranx senegallus*) and Gorean snapper (*Lutjanus goreensis*) were prominent in all the fishing communities and were smoke-dried by the application of traditional processing technologies to meet the expectations of final consumers, prospective buyers and the market standard.

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