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# The Effects of Freezing and Smoking on the Proximate Composition of Fresh Catfish (*ClariasGariepinus*)

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A B S T R A C T

The effects of freezing and smoking on the proximate composition of the African mud catfish, Clariasgariepinus were investigated One portion of the harvested fish was smoked using a smoking kiln at 60-70$^0$C for 24hours and stored in a polythene bag for further use. Another batch of C.gariepinus was preserved immediately after harvest in a freezer at less than –0$^0$C for 4 days. The third batch of the live fish was slaughtered immediately and prepared for proximate and microbial analysis. The proximate analysis revealed that the Moisture in fresh C.gariepinus was 70.10%, in frozen was 71.07% and in smoked was 11.4%, Protein in fresh, frozen and smoked C.gariepinus were 20.22%, 18.32%, 60.56% respectively, Ash in fresh, frozen, and smoked C.gariepinus were 3.58%, 4.20%, 5.70%, Fat in fresh, frozen and smoked C.gariepinus were 3.28%, 3.45%, 14.29% and CHO in fresh, frozen and smoked C.gariepinus were 2.81%, 2.97%, 8.04% all respectively In conclusion, smoking demonstrated a better efficient method of fish processing in terms of the retention of the protein value and reduction in moisture content.

Keywords: Fish, Freezing, Smoking, Drying.

## 1. Introduction

Fish constitute a very important component of diet for many people and often provides the much needed nutrient not provided in cereals based diets. It provides between 30% and 80% of the total animal protein intake for coastal people of West Africa. Fish is a highly perishable commodity which can record considerable losses in quality before consumption. In Nigeria, estimate of 40% post harvest losses of total fish landing have been reported. Earlier, May boom reported that 15%of the total fish caught in the kanji lake was lost due to spoilage between the source of supply and consumers.

Locally, fish spoilage has been known to be influenced to a large extent by high ambient temperatures, considerable distance from landing sites as well as poor and inadequate infrastructure for post harvest processing and landing. Smoking and freezing are among the commonest method used for fish preservation in Nigeria. In Nigeria, fish is eaten fresh and smoked and from a much delicacy that cut across socio-economic; age religion and educational barrier. Adebayo-Tayo, B. C., Onilude, A. A., & Patrick, U. G. (2008).

Fish is usually marinated in brine or packed with salt and can trigger high blood pressure in high doses *(Nummer&Andress 2002)*. In addition, improper fish curing before smoking presents the risk of food poisoning that can lead to bacterial infection, listeriosis in the consumer and bacterial of fungal growth on the fish (*Steck, S. E., Gaudet, M. M., Eng, S. M., Britton, J. A., Teitelbaum, S. L., Neugut, A. I., … Gammon, M. D. 2007)*. However, the authors noted that if properly prepared and eaten in moderation, the highlighted problems may be initiated. Presently, the only means of preserving fish in its original fresh state is by freezing. The aim of freezing of food items is to combine shelf life extension with maintenance of sensory and nutritional characteristics. Jones (2006) reported that at low temperature (i.e below -10$^0$c) bacterial action will be hindered by the freezing process. The aim of the research work is to determine what effect freezing and smoking has on the proximate composition of the catfish.

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## 2. Materials and Methods

### *2.1 Sources of Materials*

The samples of African mud catfish (*Clariasgariepinus*) were obtained from the fish farm at Oja-odan in Ogun State Nigeria. The fish samples were transported live to the laboratory and divided into three batches: two batches were prepared separately for smoking and freezing while the third was sacrificed immediately and analyzed for proximate

### *2.2 Methods*

***2.2.1 Smoking Technique-*** The fish sample was slaughtered, gutted and washed thoroughly with clean water and were laid on the racks of the smoking klin. Heat was generated by the burning of charcoal from log of wood and the smoking of the sample was carried out at 60-70$^{o}$C for 24hrs. After smoking, the product were packed in polythene bag to reduce pest/microbial infestation and kept in the refrigerator for 4days.

***2.2.2*** **Freezing Technique** - The fish was slaughtered, gutted and washed with clean water to remove traces of blood and spilled enzymes, wrapped tightly in plastic wrap and were stored immediately in the freezer for 4days at below 0$^{o}$C.

## 3. Analysis

### *3.1 Proximate Analysis*

Proximate analysis was carried out on moisture content, protein, fat, ash, fiber by using AOAC (2010) method while carbohydrate was determined by difference of the sample.

***3.1.1 Determination Of Moisture Content*** - Moisture was determined by the reduction in weight when the sample was dried to a constant weight in an oven. About 2g of fish sample was weighed into a silica dish which was previously dried and weighed the sample was dried again in an oven at 65$^{o}$C for 36h, cooled in a dessicator and weighed. This process was continued until a constant weight was achieved.

$$\% \text{ moisture} = \frac{\text{weight of sample + dish before drying - weight of sample + dish after drying}}{\text{Weight of sample taken}} \times 100$$

***3.1.2 Determination Of Crude Fat-*** The ether extract of a feed represent the fat and oil in the feed. Soxhlet apparatus is the equipment used for the determination of ether extract. It consist of three major components; an extractor: comprising the thimble which holds the sample, a condenser: for condensing and cooling the ether vapor and 250ml flask. About 150ml of an anhydrous diethylether (petroleum ether) of boiling point of 40-60$^{o}$C was placed in the flask. 2-5g of the sample was weighed into a thimble and the thimble was plugged with cotton wool. The thimble with content was placed into the extractor; the ether in the flask was then heated. As the ether vapor reached the condenser through the sidearm of the extractor, it condensed to liquid form and dropped back into the sample in the thimble; the other soluble substances were dissolved and carried into solution through the siphon tube back into the flask.
The extraction continued for at least 4 hours. The thimble was removed and most of the solvent was distilled from the flask into the extractor. The flask was then disconnected and placed in an oven at 65$^{o}$C for 4hours, cooled in a dessicator and weighed.

$$\% \text{ Crude fat} = \frac{\text{weight of flask + extract – tare weight of flask}}{\text{Weight of sample}} \times \frac{100}{1}$$

***3.1.3 Determination of Crude Ash*** - Ash is the inorganic residue obtained by burning off the organic matter of the samples at 400-600$^{o}$Cin a muffle furnace for 4hours. 2g of the sample was weighed into a pre-heated crucible. The crucible was placed in muffle furnace at 400-600$^{o}$C for 4hours or until a whitish-grey ash was obtained and then was placed in the dessicator and weighed

$$\% \text{ Crude ash} = \frac{\text{weight of crucible + ash – weight of crucible}}{\text{Weight of sample}} \times \frac{100}{1}$$

***3.1.4 Determination of Crude Protein*** -- In this method, the fish sample to be analyzed was digested with concentrated sulphuric acid in the presence of a small amount of copper sulphate with mercury (Hg) as a metal catalyst. Under these conditions, the organic matter was oxidized and the protein nitrogen was converted to ammonium sulphate $(NH_4)_2SO_4$. The digestion was followed by the addition of a strong base (NaOH) to liberate ammonia. The ammonia distilled, trapped in0.5% boric acid indicator which was then titrated with 0.01ml HCl. Almost all form of organic nitrogen were converted to ammonia by

the conditions of the digestion. The result of kjedahl analysis is usually expressed as crude protein. The weight of nitrogen in a sample can be converted to protein using the appropriate factor based on the percentage of nitrogen in the protein sample. To convert gram of nitrogen to gram of protein, the common factor 6.25 was used. The nitrogen value was therefore multiplied by 6.25 to get the weight of protein.

$$\%N = \frac{\text{molarity Hcl x sample titre} - \text{Blank titre x } 0.014 \text{ x } 0_f \text{ x } 100}{\text{Weight of sample used} \qquad 1}$$

%N was converted to the percentage crude protein by multiplying by 6.25.

***3.1.5 Determination of Crude -*** Two hundred (200ml) of freshly prepared 1.25% $H_2SO_4$ were added to a known weight of the residue obtained from fat extraction and this was brought to quick boil. Boiling was continued for 30mins. The mixture was filtered and residue was washed until it was free from acid. The residue was transferred quantitatively into a digestion flask, 1.25%NaOH was added and brought to boiling point quickly. Boiling was continued for 20minutes. The residue was then washed with methylated spirit twice with petroleum ether using small quantities. It was allowed to properly drain and the residue was transferred into a silicon dish (previously ignited at 600$^o$C and cooled). The dish and its content were drained to constant weight at 105$^o$C. The organic matter of the residue was burnt by igniting for 30mins in a muffle furnace at 600$^o$C. The residue was cooled and weighed. The loss in ignition was reported as crude fiber (AOAC 2010).

$$\%\text{ Crude fiber} = \frac{\text{dry wt. of residue before ashing} - \text{wt. of residue after ashing}}{\text{Weight of sample}} \text{ x } \frac{100}{1}$$

***3.1.6 Carbohyddrate Determination -*** The carbohydrate content was calculated by difference.

%CHO – 100 (sum of percentages of moisture, ash, fat, protein and crude fiber).

## 4. Results and Discussion

### *4.1 Results*

**Table 1: Percentage mean proximate values of fresh, frozen and smoked *C.gariepinus.(%)***

| | SAMPLES | | |
|---|---|---|---|
| PARAMETERS | FRESH | FROZEN | SMOKED |
| MOISTURE | 70.10±0.34 | 71.07±0.15 | 11.41±0.13 |
| PROTEIN | 20.22±0.26 | 18.32±0.03 | 60.56±0.54 |
| ASH | 3.58±0.03 | 4.20±0.08 | 5.70±0.04 |
| FAT | 3.28±0.10 | 3.45±0.06 | 14.29±0.04 |
| CARBOHYDRATE | 2.81±0.14 | 2.97±0.26 | 8.04±0.54 |

*Values of triplicate experiment ± the standard deviation*

### *4.2 Discussion*

Table 1 shows the result of the proximate composition of catfish subject to freezing temperature and smoking and fresh served as the control; It was observed that the moisture content ranged from 11.41% to 71.07% of which the frozen sample has the highest moisture content but varies slightly to the fresh sample and has a drastic reduction in the smoked sample. The low moisture content in the smoked is an evidence of long shelf life compared to other samples. The result of the moisture content is similar to that reported by (Olayemi*et al* 2011) who reported 78.70% and 7.3% for fresh and- dried catfish and the high amount of moisture present in fresh and frozen sample showed that catfish is highly perishable, urgent step must be taken for its protection against destructive agent. The protein content ranged from 18.32%to 60.56%, of which the smoked sample has the highest protein content. Fish protein is a high quality protein that in easily digestible and fish diets reduce levels of cholesterol in the blood, therefore reducing risk of heart disease, satisfying the indispensable amino acid requirement of a species is utmost importance in preparing well balance diets (Morris 2001). The high protein content recorded in smoked sample is attributed to the removal of moisture thereby concentration the protein in the fish. The quality of the fish protein is superior to that which could be obtained from milk, meat and egg. Abolagba*et al* (2015) it is reported in literature that fish has well balanced amino acid (Ashraf *et al* 2011). The result obtained for the smoked sample was similar to that reported by (Yakubu and Ngueku 2015) who worked on the quality assessment of smoked, dried catfish from the five different markets in Lafia Nigeria. The fat content ranged from 3.28% to 14.29% and it was observed that the fresh sample has the least fat content and the smoked sample had the highest fat content which means the freezing process has a little effect on the fat content

but the increase in the fat contents in the smoked sample is attributed to the loss of moisture thereby concentrating the lipid content. The lipid composition also may varies due to maturity of the catfish; lipid content is higher in adult than juvenile (Obarah et al 2009).

The lipid content obtained from the fresh and frozen is similar to that obtained by (Roopma et al 2012) who reported 3.86 %for fresh and 4.60% for frozen. Fat plays a significant role in the shelf life of food product and can promote rancidity leading to the development unpleasant and odourous compound (Iherekomye and Ngoddy 2005). The Ash content ranged from 3.58% to 5.70%, with fresh sample having the lowest and the smoked having the highest. The ash content is an indication of mineral element. The result frozen and fresh sample is similar to that reported by (Aranmilewa et al 2005) which reported a little increase in the ash content of fresh and frozen tilapia fish. The carbohydrate content ranged from 2.81% to 8.04% with the smoked having the highest CHO content however, the decrease in moisture content is also attribute to the increase in CHO content of the smoked sample. This work is similar to that reported by (Sajib Al-Reca et al 2015) who reported 1.71% for frozen fish and 4.03% for smoke Laubukadadiburjori.

## 5. Conclusion

In conclusion, the results obtained in the study showed that there significant influences of smoking and freezing on the nutritional value of the catfish, C. gariepinus. The results indicated that two processing methods are efficient in the post harvest management of fishery products. Smoking demonstrated a better efficient method of fish processing in terms of the retention of the protein value and reduction in moisture content. The knowledge obtained in this study could improve the preservative strategies of dried fish and thus prolong the shelf life of one commercially important food commodities in Africa.

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