Biochemical Evaluation of Hot-Smoked African Catfish (*Clarias gariepinus*) Sampled from Sango and Ota Markets in Ogun State.

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ABSTRACT

This study evaluated the biochemical stability of hot-smoked African catfish, *Clarias gariepinus,* retailed in Sango and Ota markets in Ogun State, Nigeria. Six smoked fish retailers were randomly selected from the markets and from which 36 fish samples were collected. The samples of smoked catfish were assessed weekly for a period of six weeks. Proximate composition was assessed using changes in moisture content and crude protein. Biochemical indexes evaluated were: Total volatile nitrogen (TVN), pH value and peroxide value (PV). In this study, the result of the proximate analysis showed there was a slight increase in the moisture content (21.47-26.05%) and decline in the protein content of the samples on weekly basis. Also, the biochemical parameters increased with storage time in the hot-smoked *Clarias gariepinus* samples, the ranges are TVN (13.65-31.52 mg/100g), pH (6.36-6.69), and PV (3.42-25.54Meq-kg). The hot-smoked *Clarias gariepinus* from the markets could not keep well till the 6th week, deterioration in fish post-harvest qualities were noticed from the 5th week of storage. Therefore, it can be inferred that smoked catfish with moisture content of about 10% or less have a shelf life of about 4-5 weeks under ambient storage conditions.

(Keywords: hot-smoked, *Clarias gariepinus,* Sango and Ota markets, proximate composition, biochemical indexes, ambient storage conditions, food preservation)

INTRODUCTION

Catfish is an important protein food in the tropics, in Nigeria as fish constitutes 40% of the animal protein intake of the people (Olatunde, 1989). Available records show that about 40% of the total fish catch in Nigeria are lost annually due to inadequate or poor preservation, processing and handling (Oladosun *et al*., 1996). The rate of fish spoilage depends on handling during processing, acidity level, species of fish, weather, mode of storage, and temperature during transportation (Clucas, 1982). Chemical break down of protein, fat and water contents contribute to quick spoilage of fish. Therefore, preservative methods that include the use of smoking is inevitable so as to preserve the physical and chemical (nutritional) qualities, enhance the economic value and prolong the shelf-life of smoked catfish as a veritable protein source.

The most affordable and widely used preservation is smoking (Eyo, 1993). The primary aim of hot smoking is to preserve the product, flavour and colour arising as a result of preservation function. However, smoked fish and shellfish products have shown to deteriorate in quality with storage time and temperature (Lima des Santos, 1981; Daramola *et al*, 2007). Therefore, the broad objective is to study the changes in the biochemical qualities of hot-smoked African catfish, *Clarias gariepinus* samples purchased from Ota and Sango markets stored under ambient conditions for a period of six weeks.

MATERIALS AND METHOD

The smoked fish samples used were purchased from Oja-Ota and Sango market, Ogun State. A preliminary investigation was made on the two markets. Six samples were purchased from each of the six retailers (50% of the retailers), making a total of thirty six whole smoked fish samples for the experiment.

The selected samples for the study were coded as follows:

SMR 1→ Sango Market Retailer 1;
SMR 2→ Sango Market Retailer 2;
SMR 3 → Sango Market Retailer 3;

OMR 1→ Ota Market Retailer 1;
OMR 2→ Ota Market Retailer 2;
OMR 3→ Ota Market Retailer 3.

Samples of smoked fish were then moved into the Bells University Research Laboratory for the weekly biochemical analyses.

Moisture Content: Properly grinded smoke-dried *Clarias gariepinus* sample (5g) was oven-dried at 105^0C in a moisture can.

Crude Protein: Using micro-Kjedahl distillation method (A.O.A.C. 1990).

Total Volatile Nitrogen (TVN): A Kjedahl distillation apparatus (Kjektec 2200 model) with a 500ml receiving flask was used.

pH Level: Jenway pH meter (3015 model) was used weekly to assess the pH of each sample of smoked *Clarias gariepinus*.

Peroxide Value (PV): PV was determined using the method described by Pearson (1981).

Statistical Design and Analysis

Completely Randomized Design (CRD) was adopted in carrying out the experiment. Experimental trials were conducted in triplicates. One-way analysis of variance (ANOVA) where $P < 0.05$ was applied to the different sample values obtained. The differences among the means was characterized by the Duncan Multiple Range Test (DMRT). Statistical package for Social Science (SPSS) 16.0 software was used in the data analysis.

RESULT AND DISCUSSIONS

The chemical analyses determine the rate and extent of biodeterioration that have taken place in the hot-smoked *Clarias gariepinus* samples during storage as well as appropriate duration of storage.

Moisture Content

The moisture content can be used as a pointer to the rate at which deterioration occurred in fish samples resulting in the early decomposition. There was a gradual increase in the moisture content of all the samples purchased from the two markets with increasing storage period (Figure 1). The increase can be attributed to absorption of moisture from the surrounding since there was no re-drying during storage (Daramola *et al*, 2007). Also, Bernaseek (1991) found out that the shelf life of the smoked fish depends more on the cooking and the state of dryness of the fish than the smoke itself. A standard moisture content of 12% was reported by FAO/APHCA (1989) as the level beyond which fish products begin to grow moulds after few days. The difference in the moisture content of SMR1 in week 2 and week 3 is a slight increase of 0.10%. The increase in moisture content for SMR3 in week 0 to the recorded value in week 1 was very low compared with all other weeks. For OMR3 samples, the moisture content of the first four weeks was very close compared to that of the last two weeks.

Crude Protein

Protein decomposes with passing time (Ghezala, 1994). The crude protein for all the samples in this study decreased with increasing storage time (Figure 2). This could be due to gradual degradation of initial crude protein to more volatile products such as total volatile bases, hydrogen sulphide and ammonia (Eyo, 2001). Similar drop in protein concentration was reported for *Heterobranchus longifilis* by Abolagba and Osifo (2008). These agreed with Stround (1988), who reported that smoking process has been found to affect the nutritional value of fish, mainly by reducing the biological availability of proteins. Though SMR1 samples gave the highest crude protein value of 66.74% in week 0, it gradually decreased to 37.08% in the final week of the study. For OMR2 sample, the rate of decrease in crude protein at week 4 to week 5 was very low compared to all other samples. The lowest crude protein recorded was 33.48mg/100g for OMR1 sample in week 5 of the study.

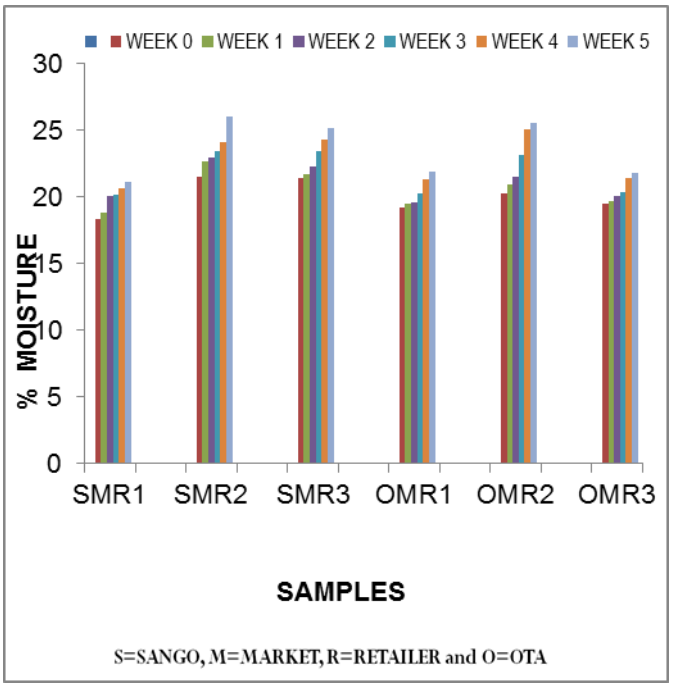

Figure 1: Mean Moisture Content of Hot-Smoked *Clarias gariepinus* Samples.

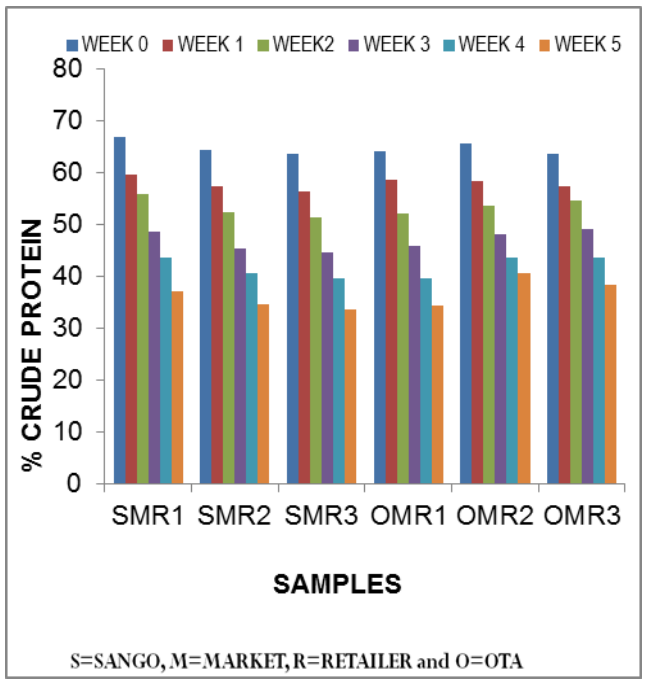

Figure 2: Mean Crude Protein for Hot-Smoked *Clarias gariepinus* Samples.

Total Volatile Nitrogen (TVN)

Total Volatile Nitrogen is widely used as an indicator of the degree of lipid oxidation. There was a continuous increase in the TVN of all the samples all throughout the period of storage (Figure 3). The work of Trinidad and Estrada (1986) revealed an increase in value of TVN produced in smoked Tilapia fish from 4.2 mg to 11.00mg in less than 15 hours. During hot smoking, fish are exposed to heat and atmospheric oxygen. These factors can accelerate the oxidation of the fish lipids resulting in an increase in TBA (Bilgin and Gunlu, 2008). OMR1 samples gave the lowest TVN value of 13.65mg/100g in week 0 while the highest TVN value recorded was 33.92mg/100g for SMR3 samples in week 5 from 28.86mg/ 100g in week 4.

Kirk and Sawyer (1991), suggested a value of 30-40mg N per 100g as the upper limit. Also, Connell (1995) stated that the limit of acceptability of fish is 30mg N per 100g. These was further corroborated by Eyo (2001) who reported that the peroxide values corresponding to incipient spoilage are usually in the order of 20-40 milliequivalents of oxygen per Kilogram of sample (ml per Kg). As at week 3 of the analyses, the TVN of all the samples were above 23mg/ 100g which shows that decomposition had set in.

pH value

Though most of the retailed hot smoked *Clarias gariepinus* samples used in this study had an initial pH value close to neutral, the acidity of the sample increased by the week with storage time (Figure 4). Osibona *et al*., (2010) reported the pH in fresh fish flesh to be almost neutral while in post-mortem periods, composition of nitrogenous compounds leads to an increase in pH in the fish flesh (Shenderyuk and Bykowski,1989). The pH value of SMR1 samples increased by the week, but then dropped in week 4 and later increased in week 5. Also, the pH value of SMR2 samples reduced from 6.59 in week 0 to 6.48 in week 1 after which there was a consistent increase till the final week of the analysis. There was a general increase in the pH value of SMR3, OMR1 and OMR3 all through the period of storage, while a decrease was recorded for the pH value of OMR2 in week 1 after which it continually increased till the final week.

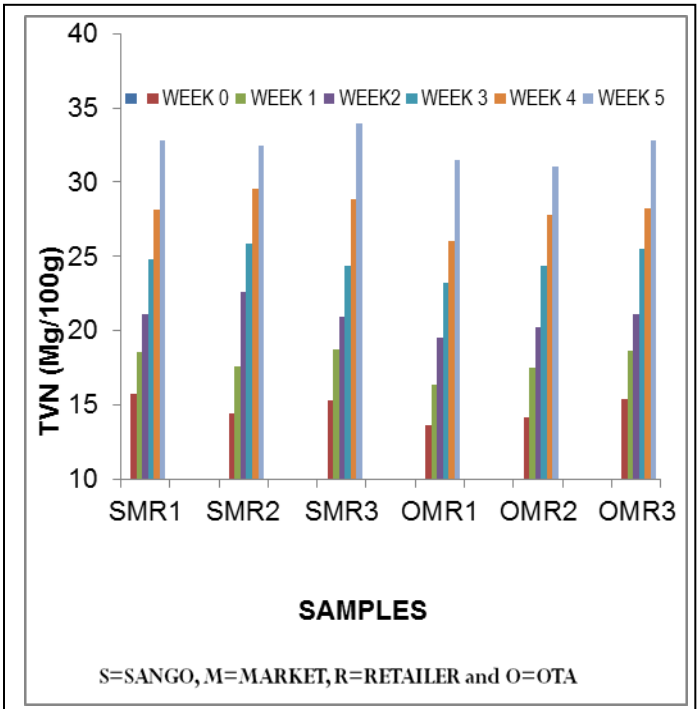

Figure 3: Mean Total Volatile Nitrogen for Hot-Smoked *Clarias gariepinus* .

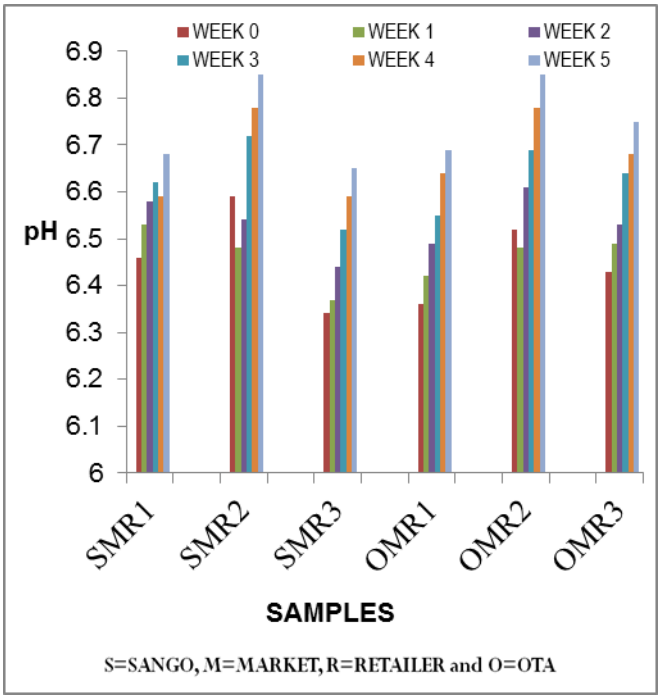

Figure 4: Mean pH Values for Hot-Smoked *Clarias gariepinus* Samples.

Peroxide Value (PV)

The extent to which rancidity reaction have occurred in the hot smoked *Clarias gariepinus* sample during the storage period was determined by the measurement of the Peroxide Value (PV) of the oil. Meanwhile, the PV is a product of oxidation or the amount of peroxide oxygen per 1kg of fat or oil. As oxidation proceeds, peroxide breaks down aldehydes or combines with proteins (Woyewoda *et al.,* 1986). Some phenolic substances have preserving effects on the smoked product by delaying oxidation and rancidity of the highly unsaturated fish lipids (Sveinsdottir, 1998).

The lowest PV recorded in week 0 of the analysis was 1.6Meq/kg for OMR1 sample (Figure 5). PV for all the samples from both Sango and Ota markets retailers increased throughout the period of analyses. There was a large increase in the PV of 13.48Meq/kg for SMR2 sample in week 4 to 21.39Meq/kg in week 5. As at week 5 of the study, OMR1 sample gave the lowest PV of 17.48Meq/kg while the highest PV recorded was 25.54Meq/kg for OMR3 samples.

Beltran and Moral (1989) also found that hot smoking caused a several-fold increase in PV and TBA in sardine fillets.

CONCLUSION

The results of biochemical analyses carried out proves that the hot-smoked *Clarias gariepinus* available in the two study sites are fit for human consumption as at the time of purchase. However, subsequent sundrying or mild smoking is required to keep the fish product longer from deterioration. Therefore, a properly hot-smoked *Clarias gariepinus* with moisture content of about 10% or less can have a shelf life of about 4-5 weeks under appropriate storage condition. If not properly stored the efforts involved in smoking would not yield the expected preservative effect.

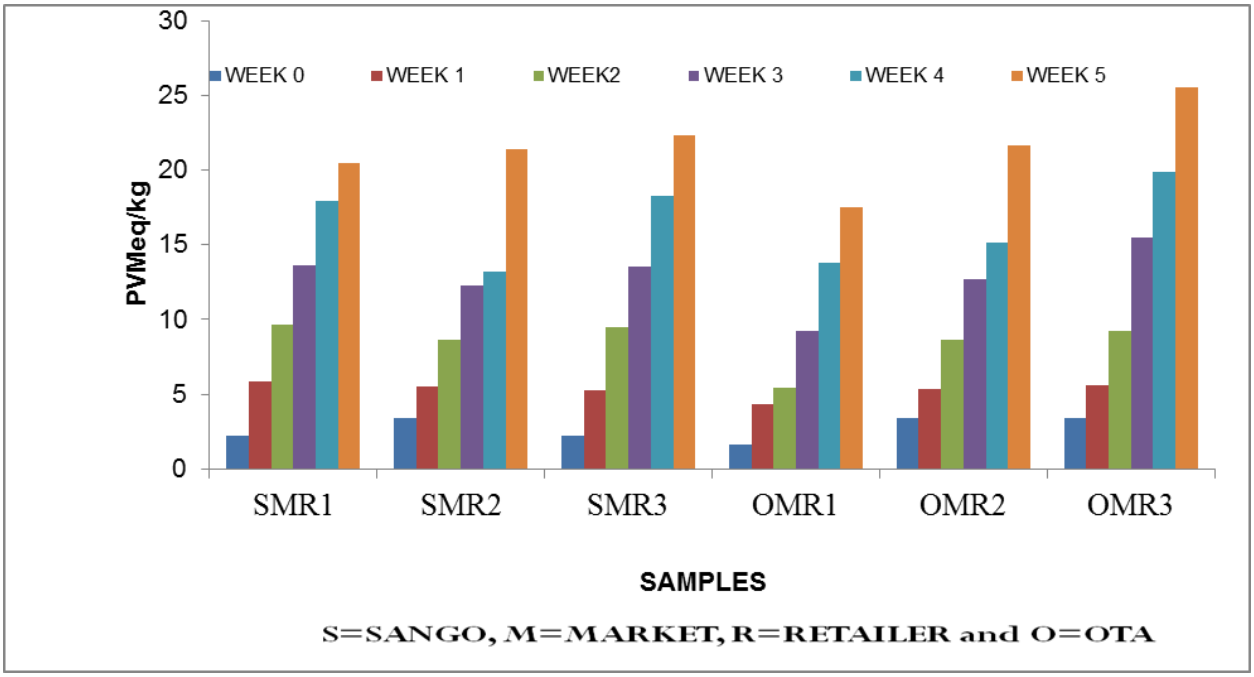

Figure 5: Mean Peroxide Values for Hot-Smoked *Clarias gariepinus* Samples.

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