EFFECT OF COLD AND HOT SMOKING OF *CLARIAS GARIEPINUS* ON CONSUMER PREFERENCE

E.O ADEPARUSI [a], J.A DARAMOLA* [b] and S.O BADEJO
[a]Department of Fisheries and Wildlife, Federal University of Technology, P.M.B 704, Akure, Nigeria.
[b]Department of Biological Sciences, Bells University of Technology, P.M.B 1015 Ota, Nigeria.
E-mail: dabolgp@yahoo.com

Abstract
The objective of this study was to determine the best smoking method that will enhance consumer preference for Clarias gariepinus without affecting negatively the nutritive value. Two methods of smoking were used: cold and hot smoking. The fish were smoked with improvised drum smoking kiln and oven. Smoked fish samples obtained were subjected to chemical analyses and sensory evaluation. Chemical analyses showed that the smoked fish were still rich in protein (66.00-67.52%) and fat (9.83-12.28%); while the moisture content ranged between 7.82-8.24% and ash, 12.86-14.16%. There was no significant difference ($P>0.05$) in the protein, ash and moisture contents. Significant differences ($P<0.05$) were observed in the Calcium(Ca), Potassium(K), Sodium(Na), Zinc(Zn), Lead(Pb), Iron(Fe) and Phosphorus(P) contents. Only hot smoke-dried (HSD) fish samples showed no presence of lead. The levels of sodium(Na) and potassium(K) in the smoked fish were relatively high, though, the amount of potassium(k) was higher. Sensory evaluation results revealed that there were no significant differences ($P>0.05$) in the colour and taste ratings of the smoked fish samples. However, significant differences ($P<0.05$) were observed in the odour, texture and overall acceptability. Hot smoke-dried and cold oven-dried *Clarias gariepinus* had the best overall acceptability in ratings.

Introduction

Fish is consumed as food and an important contributor to the national economy. It is readily available in most markets either as fresh, smoked, dried, canned, chilled or frozen. Almost 90% of fish production in Nigeria is from the artisanal sector. They live in remote areas, where there are limitations of infrastructure facilities (Talabi and Igbinosun;1975). Fish muscle contains four basic nutrients in varying proportions water 70 80%, protein 16 25%, lipids 1 5% and vitamins (Clucas, 1982).

However, inspite of the valuable nutrients derived from fish, it is a highly perishable commodity. Fish flesh contains the nutrients necessary to support the growth of a wide range of micro-organisms at death. The post harvest changes (physical and chemical) in the quality of fish as food depends on the method of catch, handling procedure and the natural course of events in the body of post-mortem fish (Balogun, 1998). This alteration in components continues when left unchecked until the fish becomes unwholesome and unfit for consumption or can be prevented through preservation.

Preservation can be achieved by creating conditions on or inside the fish totally unsuitable for the optimum operation of bacteria and enzymes. Actions of bacteria and enzymes can be suppressed by the application of high temperature techniques like smoking and sun-drying, and addition of salt. However, most of the fish produced by the artisanal fisherfolks are marketed as smoked fish, since there is no alternative method of preservation they could employ to distance consumer markets (Eyo, 2001). After smoking, fish have variable moisture content depending on the extent of dehydration, some may become very dry and brittle due to over-heating while others may retain a soft texture when substantial moisture is not removed from the fish.

Basically, smoking process preserve the fish, enhances flavour and impart good colour to the fish. This can either be cold(<30°C) or hot(>100°C) smoking (Balogun, 1998).

Cold(soft) smoking is practiced in places where alternative means of preserving the fish such as refrigeration is available; it retains the nutritive value of fish. Cold smoked fish has shorter life span as moisture retention may be in the order of 35-45%.

Hot (hard) smoking is the traditional method of fish smoking in the tropics. Fish is smoked until cooked in order to extend it's shelf life.

However, consumer's preference for cold and hot-smoked fish differs considerably based on taste, personal likeness e.t.c. Therefore, the essence of this study is to assess characteristics of the difference in consumer's preference for either cold or hot smoked fish.

Materials and Methods

Fourteen live samples of *Clarias gariepinus* were bought from a fishermen in Akure. The specimens were caught with cone-shaped bamboo traps. The fish were then gutted and re-washed, the mean weight was 4.280kg. Due to their big sizes, they were cut into chunks to allow for proper drying and assessment. Drying was done in two ways: hot smoking was done using smoking kiln while cold smoking was carried out with the oven. The smoking kiln was made up of metal drum, horizontally cut into two. The height of the kiln was 55.5cm and width was 241.9cm. A rectangular reinforced wire mesh (4.5cm) was placed and firewoods were arranged in the drum opening. Fire was ignited using kerosene and matches. Thermometer was placed close to the wire mesh to take the temperature. The mean temperature was 98°C. Fish were then arranged on the wire mesh for smoking. Turning was made intermittently at intervals until the fish showed considerable level of dryness, after 6 hours of smoking.

This was classified as Hard Smoke Dried (HSD). For Soft Smoke Dried (SSD), the mean temperature of the kiln was 30°C and smoking was done for 4 hours. Oven drying was carried out using an electric oven (Binatone 07 2001DX). At the onset of the process, the oven was on for five minutes to heat up the drying compartment to 30°C. After this, the door was opened and fish was arranged in the drying tray and the door firmly closed. The oven drying continued for 2 hours, after which the fish was observed cooked. This was classified as Soft Oven Dried (SOD). For Hard Oven dried (HOD), temperature of the oven attained 100°C and fish ware arranged in the drying tray. Drying continued for 3 hours to get the fish dried. After cooling, each product was packed in polythene bags and labelled for assessment and analyses. Organoleptic test was carried out using a questionnaire with a 9-point hedonic scale and distributed to 10 tested and trained judges. Ranking was done individually. Warm water was made available for the panelists to rinse their mouth before tasting another product. Proximate analysis (moisture, ash, crude protein and fat content) was carried out according to A.O.A.C (1990). Zinc, Iron, Magnesium, Calcium, Sodium, Potassium, Copper, Selenium and Lead contents were determined on ashed samples using a Buck model 200A flame atomic absorption spectrometer (I.I.T.A, 1982), while phosphorus content was determined using the Vanado-molybdate method. The statistical significance of the observed differences among the means of triplicate readings were evaluated using analysis of variance (ANOVA), while means were separated using Duncan's Multiple Range Test. These analyses were carried out using GenStat 6.1 (2002) computer program.

Results and Discussion

The results obtained for mineral, proximate, and sensory evaluation are as presented in Table 1, Figs. 1 and 2 respectively. The mineral composition of the smoke-dried fish is shown in Table 1. There are marked variations in the mineral composition of the smoked-dried fish samples. Significant differences were observed in the Ca, K, Na, Zn, Pb, Fe and P contents. Only sample HSD shows no presence of lead. Thus, it would be the most preferred from the toxicological point of view for human consumption. However, this sample also had the lowest Ca and P. The levels of sodium and potassium in the processed fish samples are relatively high, although the amount of potassium present is higher.

The low sodium level may suggest that the sodium levels in the diet on which fishes are fed is low. This appears so in view of the report of Olaofe and Sanni (1988) that sodium levels in Nigerian plant foods are generally lower than the potassium. The high value obtained for the ash may be due to the fact the fish samples were not deboned after smoking; whole fish were dried and milled with the flesh. However, the mineral content of fish is species specific (NRC, 1983).

Fig. 1 shows the results of the proximate analysis of *C. gariepinus* subjected to different smoking operations. There was no significant difference ($P > 0.05$) in the proximate analysis result except in the fat content .This result shows that they are good sources of protein (66.00 67.52%), fat (9.83 12.28%) and ash (12.86 14.16%). In all the batches, there were no significant difference ($P > 0.05$) in the protein, ash and moisture content. Thus, the protein and ash content of the samples appears to be independent of the methods of smoking. Significant difference ($P < 0.05$) was recorded in the fat content, with sample SOD having the lowest value while HSD had the highest. The variation observed in the fat content could be attributed to the processing treatment given to the sample. The samples with the higher values were the Hard oven dried (HOD) and Hard smoke dried (HSD). The fat content of the fish samples compare favourably with the values reported for haddock (14%) but differs significantly from herring (60%) (Clowick and Kaplan , 1969). Hence they do not qualify as true oil fishes. With the protein content of the samples ranging between 66.00 67.52%, they would be capable of meeting the required daily intake (RDI) of infants and adults fed solely on it (PAG, 1971). Less than 100g of the fish samples would have to be consumed by an adult weighing 70kg to meet the daily protein requirement of 55g (FAO/WHO/UNU, 1985 and Robinson, 1987).

The result of the sensory evaluation is presented in Fig. 2. Judges ratings showed that consumers preferred oven dried fish samples, that is Hard oven dried (HOD) and Soft oven dried (SOD). For oven dried fish samples, there were consistencies in the Judges assessment of the colour, aroma, taste, texture and overall acceptability of the smoked fish.

References

Talabi, S.O. and Igbinosun, J.E (1975). A new equipment for smoke-drying of fish in Nigeria. NIOMR Tech Paper 33.

Clucas, I.J., (1982) Fish handling, preservation and processing in tropical part 2. Tropical Development and Research Institute pp 13 14.

Balogun, A.M. (1998). The Sanctity of fish as food. Inaugural Lecture Series 14 pp 18.

Eyo, AA (2001). Fish Processing Technology in the topics. Published by National Institute for Freshwater Fisheries Research (NIFFR), New Bussa. University of Ilorin press, Nigeria. Pp 1-23.

AOAC (1990) Official Methods of Analysis (15th Edition) Association for official analytical Chemist, Washington D.C. International Institute of Tropical Agriculture (I.I.T.A) (1982). Automated and semi automated methods of soil and plant analysis. Manual series No 7. (Juo. A.S.R.) Ibadan.

GenStat (2002). Genstat for Windows 6th Edition Release 6.1. VSN international LTD, Oxford, United Kingdom.

PAG (1971) Protein Advisory Group Guideline no 8, Protein-rich mixtures for use as wearing foods. New York: FAO/WHO/UNICEF.

FAO/WHO/UNU (1985). World Health Organisation (WHO) Technical Report Series 224. Food and Agricultural Organisation, Geneva.

Robinson, D.E. (1987) Food Biochemistry and Nutritional Value. Longman Scientific and Technical, London, United Kingdom.

Clowick, S.P. and Kaplan, N.O. (1969). Methods of Enzymology. Volume 14, academic Press, New York and London.

Olaofe, O and Sanni, C.O. (1988). Mineral contents of agricultural products Fd. Chem. 30, 73-77.

National Research Council (NRC) (1983). Nutrient requirements of warm water fishes and shellfishes (Revised Edition). National Academy Press. Washington D.C

1 : Mineral composition of *C. gariepinus* subjected to different smoke drying Operations (% dry matter)

Samples	Mg	Ca	K	Na	Cu	Se	Zn	Pb	Fe	P (mg/100g)
HOD	^{a}23.95 ± 0.69	^{c}46.52 ± 1.34	^{b}50.04 ± 1.34	^{b}41.80 ± 1.21	ND ND		^{c}20.69 ± 0.60	^{a}0.39 ± 0.01	^{c}10.91 ± 0.31	^{a}371.45 ± 10.72
HSD	^{a} 23.47 ± 0.68	^{a}26.80 ± 0.77	^{b}51.95 ± 1.50	^{b}42.91 ± 1.24	ND ND		^{b}18.40 ± 0.53	ND	^{d}22.91 ± 0.66	^{a}368.80 ± 10.65
SOD	^{a} 24.53 ± 0.71	^{b}31.15 ± 0.90	^{a}45.00 ± 1.30	^{a}37.46 ± 1.08	ND ND		^{a}9.43 ± 0.27	^{b}1.75 ± 0.05	^{b}7.65 ± 0.22	^{b}439.16 ± 12.68
SSD	^{a} 24.85 ± 0.72	^{b}31.09 ± 0.90	^{a}47.88 ± 1.38	^{a}41.05 ± 1.19	ND ND		^{b}18.29. ± 0.53	^{c}5.02 ± 0.14	^{a}5.02 ± 0.14	^{b}452.60 ± 13.07

* Values are means of three replicates
* Values in a column denoted by different superscripts differs significantly at $P < 0.05$.

KEY; HOD - Hard Oven dried; HSD Hard Smoke Dried; SOD Soft Oven Dried; SSD - Soft Smoke Dried.

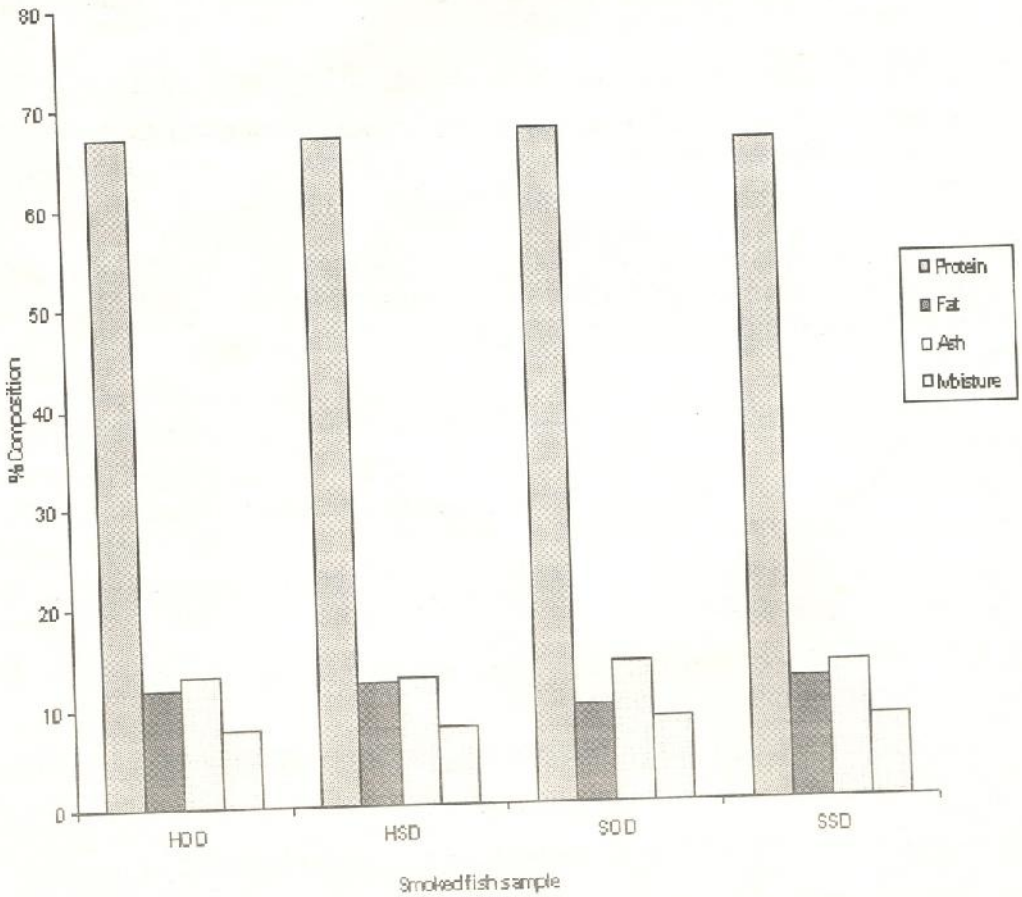

Fig 1 : Bar Chart showing the variation in the proximate composition of smoked *Clarias gariepinus*

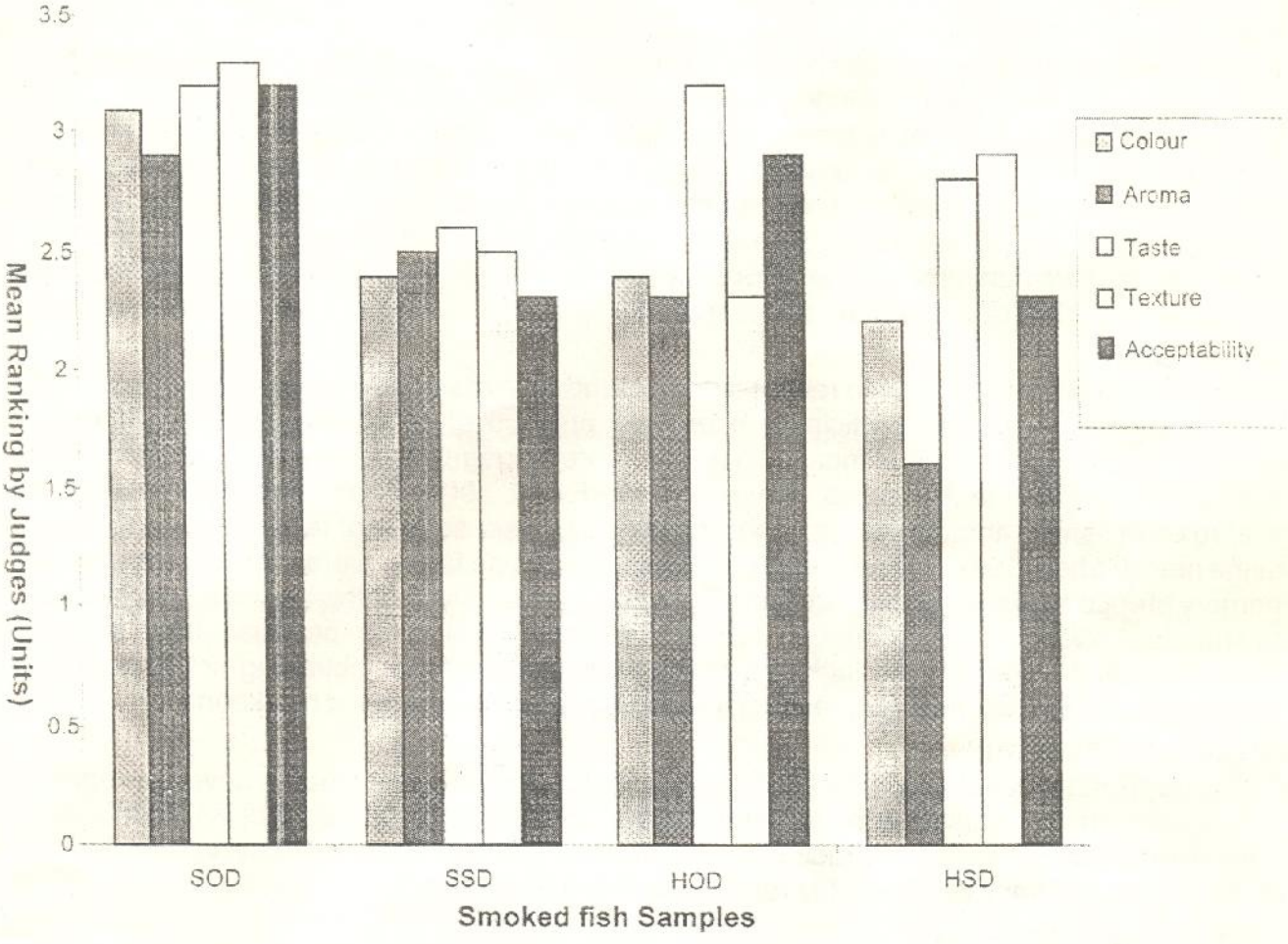

Fig. 2: Bar Chart of the Sensory evaluation of *Clarias gariepienus* subjected to different smoke-drying methods