THE EFFECT OF SMOKE DRYING TECHNIQUES ON THE PROXIMATE COMPOSITION OF FISH PRODUCTS

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ABSTRACT

Two species of fresh fish (*Sarotherodon* and *Clarias*) of uniform body weight and length were processed in the laboratory using two different smoking techniques. Same species traditionally processed were purchased from the market for comparative proximate analysis. The laboratory processed fish were directly smoked and burnt before smoking at 100°C for 4 hours and 3 hours respectively. The smoked fish were then weighed, blended and packed for proximate analysis. Moisture Content (MC), Crude Protein (CP), Fat Content (FC) and Ash Content (AC) expressed as percentages, for the various samples that were determined. Mean ± SE of MC, CP, FC, and AC were 15.45 ± 0.29, 73.76 ± 0.41, 6.16 ± 0.24 and 4.66 ± 0.60 respectively. OF the three factors studied, only specie significantly ($P<0.05$) affected moisture content, with the *Sarotherodon* specie has 1.20 percent more MC than *Clarias* species of fish and technique of smoking both significantly ($P<0.01$ and $P<0.05$ respectively) affected the CP of processed fish with *Sarotherodon* specie having 1.83 percent higher CP than *Clarias* specie and Burnt smoking having 1.07 percent higher CP than direct smoking. Fat content and Ash content were not significantly ($P>0.05$) affected by the three factors investigated.

(**Key words:** Smoking technique, *Sarotherodon sp.*, *Clarias sp.*, Proximate analysis).

INTRODUCTION

Traceable to the decimation of livestock population, fish has been accounting for about 40% of the protein intake in Nigeria for sometime (Apampa, 1984, Ekpo and Etim, 1989) reaching 6.5 to 7.5 kg per Capital consumption. The annual consumption of fish by the Nigerian population is projected to hit the 5 million metric tonnes mark at the turn of the century, however only 350,000 metric tonnes is currently being produced locally (Olufuwa, 1996).

Regrettably however, whereas estimated fish demand exceeds 1.0 million tonnes (based on 12.0kg per Caput consumption and 88.5 million population estimate (Akande and Tobor, 1992), to fish production from all sources has been declining consistently and was only 0.363, 0.343 and 0.178 million tonnes in 1989, 1992 and 1993 respectively.

This insufficiency is further aggravated by massive spoilage of fish products before it is finally consumed as a result of poor post harvest techniques comprising handling, preservation and processing which accounts for close to twenty percent (20%) spoilage of fish, (Claucas, 1976).

Some common processing techniques operational in Nigeria includes chilling, freezing, salting, canning, drying and smoking depending on the scale of production which employed application of heat to remove water and inhabit bacterial and enzymatic actions on fish is the most popular. The low cost and relative ease of carrying out this operation coupled with the odour, taste and colour of fish processed by smoking makes it a preferable technique.

Due to the problem of heat control associated with traditional smoking technique and the accompanying impairment of the nutritional value of fish protein, protein damage due to decline in lysine availability, water loss, fat diffusion and the denaturation of structural and connective tissue proteins (Talabi et al; 1983 and Akande et al, 1992), this research is intended to examine ways of reducing such adverse effects on fish products.

The objective of this study therefore is to investigate the effects of two different smoking techniques viz.: burning before smoking and direct smoking on the proximate composition of two different species of fish.

MATERIALS AND METHODS

One hundred and twenty (120) pieces of fresh *Sarotherodon* and *Clarias* species of uniform body weight and body length were obtained from Animashaun integrated farm, Ajido, Badagry. Equal number of traditionally smoked fish were also purchased from the Awolowo market, Mushin and Iyana-Iba market, Ojo, Lagos State. Thirty (30) pieces

each of the two species were randomly assigned to the two different smoking techniques studied (Burning before smoking and direct smoking) and this exercise was duplicated.

The burnt smoking technique entails the burning of the two species with grasses and leaves for about 10 – 15 minutes and further smoking at 100^{0}C for 3 hours on a traditional wood fire clay kiln with a tray placed on top.

Equal numbers of smoked fish bought from the markets were also included in this study for comparative analysis. All these variously processed fish were weighed, blended and packed in polythene bags and stores for subsequent proximate analysis.

Factors investigated in the proximate analysis were, Moisture Content (MC), Crude Protein (CP), Fat Content (FC) and Ash Content (AC) of the two species of fish subjected to two different methods of smoking and from two different origins. Statistical and analysis involves the use of Analysis of variance (ANOVA) procedure of SAS (1998). The general statistical model that best describe the study is given as follows:

$Yijkl = u + Ri + Sj + Tk + eijkl$

Where u = Population mean

Ri = The i^{th} effect of origin (i = 1,2 or i = laboratory processed, market processed).

Sj = The j^{th} effect of specie (j = 1,2 or j = *Sarotherodon* specie, *Clarias* spp.

Tk = The k^{th} effect of technology (k = 1,2 or k = Direct smoking, Burnt smoking).

eijkl = The residual random error.

Mean separation of significant effects was done using the multiple range test option of SAS (1998).

RESULTS AND DISCUSSION

The mean ± standard error (SE) of moisture content of all the fish studies was 15.45 ± 0.29 with a Coefficient of Variation (CV) of 3.52 percent and coefficient of determination (R^2) of 0.75. With the exception of the fish effect of specie which was statistically significant ($P<0.05$) on moisture content, all other factors studied did not significantly ($P>0.05$) affect moisture content of processed fish, (Table I).

Although there was a 0.60 percent difference (Table II) in the MC of the laboratory processed fish and the market processed fish, however this difference is not large enough to be statistically significant.

The excessive smoking employed traditionally in the market may be responsible for the lower MC values obtained in the market processed fish, but the fact that it is not significant ($P>0.05$) may be due to the small size of this study.

There is a 1.20 percent increase in MC of *Sarotherodon* spp., over the *Clarias* spp. (Table II) and this is significant in (Table I).

The morphological difference observed across the two species may be adduced for this marked increase in (MC) of *Sarotherodon* specie, over the *Clarias* specie.

The technique employed in fish smoking did not significantly ($P<0.05$) affect the MC of processed fish (Table I) and the mean MC of both the direct smoking and burnt smoking techniques is the same (Table II). The reason for this observation is due to the fact that after prolonged exposure to heat, fish tend to lose all the moisture it has and both (direct and burnt), thereby making the fish lose all available moisture.

The mean ± SE of crude protein investigated in this study was 73.61 ± 0.41 with a CV of 0.52 percent and R^2 of 0.94. Specie of fish highly significantly ($P<0.01$) affected the CP of fish and also the technique employed significantly ($P<0.05$) affected the CP of processed fish.

However, origin of the processed fish did not significantly affect the CP, this means that neither the laboratory processed nor the market processed significantly differ from each other.

Sarotherodon specie is about 1.83 percent higher in CP than *Clarias* specie (Table II). This observation is due to the difference in the structure and morphology of the two species. Also the positive correlation between water loss and denaturation of structural and connective tissue protein may be attributed to this observation, (Talabi and Igbinosun, 1983).

The 1.07 percent increase observed in the CP of burnt smoking technique over direct smoking technique (Table II) is due to the less exposure time of burnt smoked fish to heat relative to the direct smoked fish. Excessive heat treatment is known to impair nutritional value of fish protein (Roger, 1970).

The mean $\pm$ SE of Fat Content (FC) in this study was 6.16 ± 0.24 with a CV of 10.21 percent and R^2 of 0.51. None of the factors studied significantly ($P>0.05$) affect the FC (Table I). This result is not surprising, since the factors studied accounted for about one half of the variation observed in the FC while the unaccounted for factor is about 49 percent. This implies that this analysis probably has not identified all the various factors that may affect FC. There is medium linear relationship between the independent and dependent variables as expressed by the coefficient of determination.

It is worthy of note to state however that the FC of laboratory processed is slightly higher (0.17%) than the market processed (Table II). This observation conforms to expectation observed by Balogun (1992) stating that a lot of rancidity must have taken place as it concerns poor fish handling and preservation for various fish sold in Nigerian markets.

Also the study revealed that the *Sarotherodon* specie has less fat content (Table II) when compared to the *Clarias* specie and the burnt smoking technique has more FC than the direct smoking technique.

The mean $\pm$ SE of Ash Content (AC) in this study is 4.66 ± 0.60 with a CV of 26.93 percent and R^2 of 0.69. Although none of the factors studied was significant ($P>0.05$) in this research (Table I), however the fairly large difference in AC due to specie (2.23%) tend to be significant at probability level of 6 percent i.e. $P = 0.06$.

The small number of observation in this study is not sufficient to draw a conclusive influence on the effect of specie on AC, but this is in consonance with earlier reports of Roger (1970) which indicated that small sample size have a lot of significant effect when dealing with so many variables.

The relatively high R^2 of this analysis revealed that the model fairly perfectly describe the observation in this study. This implies that the independent factors studied accounted for almost 70 percent of the differences observed in AC.

Table I: Means Squares Analysis of Variance

		Mean Squares			
Source	**df**	**Moisture Content**	**Crude Protein**	**Fat Content**	**Ash Content**
Origin	1	0.720	0.001	0.061	0.361
Specie	1	2.880*	6.661**	1.531	9.901
Technique	1	0.000	2.311*	0.061	3.511
Error	4	0.295	0.146	0.396	1.576

* = P<0.05, ** = P<0.01

Table II: List of Means and their Respective Standard Error

Source	N	Mean ± Standard Error			
		Moisture Content	Crude Protein	Fat Content	Ash Content
Overall Mean	8	15.45 ± 0.29	73.76 ± 0.41	6.16 ± 0.24	4.66 ± 0.60
Origin					
Laboratory Processed	4	15.75 ± 0.33	73.75 ± 0.61	6.25 ± 0.31	4.45 ± 0.74
Market Processed	4	15.15 ± 0.48	73.78 ± 0.65	6.08 ± 0.41	4.88 ± 1.05
Specie					
Sarotherodon sp.	4	16.05 ± 0.22[a]	74.68 ± 0.28[a]	5.73 ± 0.2	3.55 ± 0.15
Clarias sp.	4	14.85 ± 0.33[b]	72.85 ± 0.40[b]	6.60 ± 0.29	5.78 ± 0.90
Technique					
Direct Smoking	4	15.45 ± 0.59	73.23 ± 0.57[a]	6.08 ± 0.14	5.33 ± 1.15
Burnt Smoking	4	15.45 ± 0.22	74.30 ± 0.53[b]	6.25 ± 0.49	4.00 ± 0.19

Means with different superscripts are statistically significantly (P<0.05)

CONCLUSIONS AND APPLICATIONS

The following conclusions can be drawn from this study:

That irrespective of the origin of the processed fish (laboratory or market) the values obtained for moisture content, crude protein, fat content and ash content did not significantly (P>0.05) differ.

That specie (*Sarotherodon* or *Clarias*) significantly affected only the moisture content (P<0.05) and crude protein (P<0.01) of the fish used in this study. Neither fat content nor the ash content values differ significantly (P>0.05).

That technique employed (Direct smoking or Burnt smoking) only significantly (P<0.05) affected the crude protein content in this study and it has no significant (P>0.05) effect on moisture content, fat content and ash content.

Based on the results of this study, the following applications can be recommended:

Smoking technique employed in fish preservation must be made at controlled or regulated temperature in order to minimise degradation in the quality of processed fish and also enhance preservation of fish products.

The *Sarotherodon* specie has better keeping quality than the *Clarias* specie and as such, other methods of preservation should be explored for *Clarias* in order to improve the keeping quality of processed fish.

The use of modern and improved smoking kilns should be adopted as it allows the regulation of temperature during smoking.

Burnt smoking is preferred to direct smoking because aside from the lower fuel consumption and shorter smoking time of the former, the proximate composition of burnt smoked fish products is relatively higher than directly smoked fish and also has better keeping quality than the directly smoked fish.

Finally the traditional method of smoking should be improved to minimise occurrence of chaired fish products and also reduce the risk of degradation of processed fish.

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