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COMPARATIVE EVALUATION OF THE PROXIMATE COMPOSITION OF SMOKED AND SALTED-DRIED *Oreochromis niloticus*

Ndakatu, M.A., Oyero., J.O., Mamsa, A.M,
Department of Water Resources, Aquaculture and Fisheries Technology, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State, Nigeria

ABSTRACT
This study was carried out to evaluate and compare the shelf life of smoked and salted-dried *Oreochromis niloticus* over a relative time period. Improved traditional smoking kiln and salting were employed respectively. The smoking kiln was constructed with iron metal with a dimension of 120cm x 70cm and consisting of three smoking racks with dimension of 30 x 30cm each. Table salt was used for preservation of some of the specimens. A total of 30 samples weighing 7.1kg were used. Fifteen (15) samples each were used respectively for smoking and salting. Satisfactory smoking was achieved in two days while salting to dryness was accomplished in four days. The initial percentage proximate compositions of the smoked products were 7.94%, 66. 97%, 8.`84% and 2.96% for moisture, protein, lipid and ash respectively, while that of the salted products were 8.37%, 63.93%, 12.91% and 3.95% for moisture, protein, lipid and ash. Preliminary results of the proximate compositions of the two products at the end of the fifth week of storage were as follows; 8.23%, 65.70%, 10.63% and 2.23% for moisture, protein, lipid and ash respectively of the smoked products, while 6.33%, 64.25%, 11.28% and 2.38% represent the values of moisture, protein, lipid and ash of the salted-dried products. By the individual product proximate characterization, it was discovered that both products were still relatively in good and acceptable condition. However, the protein and moisture values of the smoked products were relatively greater than those of the salted-dried products, while on the other hand, lipid and ash were relatively greater in salted-dried products. The prevailed relative higher moisture in the smoked products constitutes a predisposing condition for microbial activity and spoilage of the products, while the relative higher percentage lipid in the salted-dried products predisposes the products to lipid oxidation and rancidity.

KEYWORDS: *Oreochromis niloticus*, lipid *r*ancidity, proximate compositions, Minna.

INTRODUTION

Fish is one of the animal protein foods available in the tropics. Fish constitutes about 69.6% of the total supply of protein available to Nigeria (Fishnet, 2009). Murray and Burt, 1977) stated that the major nutrient compositions of fish tissues are protein, lipid, vitamins, carbohydrates, water and micronutrients. Fishes are therefore suitable media for rapid growth and maintenance of good health, (Jay, 1986). Fish is one of the most highly perishables of all food commodities in the tropics. The high ambient temperature in the tropics favours rapid growth of microorganisms, which harbours fish flesh causing post mortem changes and accelerate spoilage, which is responsible for about 50% wastage of the total catch worldwide (Essuman, 1992). Ogali (1994) reported that 15% of the total catch in Kainji Lake is lost due to spoilage and breakage between the source of supply and consumers and that the use of chilling, freezing and canning are not common in the tropics due to high cost, therefore, smoking is a type of preservation that readily comes to mind after a large catch, hence unsold catches were usually preserved by smoking. Losses arising from bacteria and breakdown of tissue by enzymes (catalytic spoilage) are enormous hence the need to preserve fish. Various food preservation techniques have been utilized to improve the microbial safety and extend the shelf life of fish in general, including freezing, chemical preservation, salting, and smoking, Wood, 1981. Up to 70% of the total fish catch in developing countries is preserved by smoking, a process through which volatiles from thermal combustion of wood penetrate fish flesh, Ward, 1995. In industrialized countries fish smoking serves primarily as a tool to enhance the flavor and texture of fish, thus producing value added products, Dillon et tal., 1994. Smoking usually extends the shelf life of fish due to the reduced moisture content and the effects of imparted phenolic compounds, Efiuvwevwere and Ajiboye, 1996. In addition, during hot rather than cold-smoking, high heat results in direct microbial destruction. Several studies have also been carried out on smoking by various

researchers, institutions, private businessmen and women on improving traditional methods of fish smoking through improved smoking kiln. This improvement includes construction of cheap smoking means such as drum type of smoking kiln, N.I.O.M.R smoking kiln, Altona kiln, and chorkur smoking kiln, Eyo, 1987. In Ghana, chorkur Banda was first constructed in smoking cichlid. Its efficiency is compared to the traditional constructed mud kiln. The dimension has been optimized to give best performance.

Another shelf life promoting strategy involves salting with sodium chloride or curing with chemical preservatives, Ravishankar and Juneja, 2000. The presences of sufficient salt (sodium chloride) in fish prevent or drastically reduce the action of bacteria. Salting involves the application of salt to fish either directly or as brine. Drying in the sun or mechanically using dryers may accompany salting. It remove moisture by the process of osmosis, creating medium unsuitable for microbial growth. The rate of salt uptake and moisture loss is influenced by such factors as temperature, thickness of the flesh, fattiness of the flesh, freshness of the fish and the chemical purity of the salt used for curing. The purpose of this research is to find out which of these methods of preservation, smoking or salting, gives a better proximate composition.

MATERIALS AND METHODS

Location of the Experiment

The experiment was carried out at the Fishery unit of the Teaching and Research Farm of the School Of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State, Nigeria, located on longitude 6^0 39' East and latitude 9^0 37'N of the equator. It is located in the Northern guinea savannah with distinct dry and wet seasons. It has annual rainfall of 1,200mm, with the highest mean monthly in September. Temperature ranges between 22 - 37^0C. The peaks are 40^0C in February to March and 35^0C in November to December.

Experimental Structure

A traditional smoking kiln was used. It is rectangular in shape with dimension of 120cm × 70cm size. The improved traditional kiln is equipped with 3 racks each of which can contain 15 table sized fish. After loading the fish, firewood was ignited under the firebox and the smoking operation commenced.

Experimental Fish

Thirty (30) fresh Tilapia *Oreochromis niloticus* of total weight of 7.1kg were purchased from mobil market in Minna, Niger State, Nigeria. They were gutted whole and then washed with clean tap water. They were divided into two groups of 15 each for smoking and salting respectively. Using the Improved traditional Smoking Kiln, 3kg weight of *Detarium microcarpum* wood was fed into the burning chamber, ignited and allowed to burn until heat and smoke were produced. As the wood got burned periodically, more wood were added into the heating chamber. Uniform smoking was achieved by turning the fish regularly and the smoking process took two days. After smoking, the fire was extinguished and the samples were allowed to cool sufficiently. The specimens for salting were salted for four days and both specimens were ground into powder and put into a sealed nylon bag and labeled SLTD and SMKD for salted and smoked products respectively and subjected to weekly proximate analysis. Salting was achieved by direct application of salt on the samples. This was accompanied by exposure to sun for a period of four consecutive days.

Determination of Moisture Content

For each sample, petri dish was weighed and the weight was recorded as (w_1). 5 grammes of the sample was added into petri dish and weighed as (w_2). The samples were placed in a air oven at a temperature of 105^0C for 24 hours. The samples were removed and placed in a dessicator too cool to at room temperature. The samples were removed and reweighed as (w_3). Thus percentage moisture was calculated as follows:

$$\% \text{ Moisture} = \frac{w2-w3}{W1}$$

Determination of Lipid Content

Solvent extraction (AOAC, 2000) method employing a soxhlet extractor with 1:1 petroleum spirit (40 – 60^oc and ethanol was used. Duplicates of 0.5g of treatment were put in a filter paper thimble stocked with cotton, weighed (w 1) and put in the extractor. The extractor chamber was filled to over flow into a receiving flask thereby flushing the thimble once. The extractor was filled to about two- third it volume with the set up in a bath and water from the continuously running through the condenser. Extraction was carried out for a minimum of 10 hours until colour indication of lipid clears completely from the extractor. Extracted sample in the thimble was

removed, oven dried, cooled in a desiccators and weighed again (w2). Percentage lipid content was calculated as follows:

$$\% \text{ lipid} = \frac{(w1 - w2)\ (100)}{0.5}$$

Determination of Ash Content

0.5-1g of dry matter was weighed into a crucible, incinerated in a muffle furnace (Naber model) at temperature of 500^{o}C for a period of between 24 and 48 hours. At the completion ashing, samples were cooled in a desiccators and weighed afterward to give the total organic matter (TOM) otherwise called the ash using the expression below:

$$\% \text{ Ash} = \frac{(\text{Weight of crucible + TOM}) - (\text{Weight of crucible}) \times 100}{\text{TOM}}$$

Determination of Crude Protein

Crude protein was done by modified micro Kjeldahl method (AOAC, 2000) involving basic steps; digestion, distillation and titration.

Statistical Analysis

Data were subjected to T – Test (SPSS 15.0)

RESULTS

Proximate Composition

Table 1: Weekly proximate composition of the smoked samples

	% moisture	% protein	% Lipid	% Ash
Week 1	7.84	66.86	8.69	2.90
Week 2	7.32	65.80	12.69	2.16
Week 3	8.39	66.53	8.61	2.52
Week 4	7.95	65.23	10.82	2.44
Week 5	8.23	65.70	10.63	2.23
Average:	7.95	66.02	10.29	2.85

Table 2: Weekly proximate composition of salted-sundried samples

	% Moisture	% protein	% Lipid	% Ash
Week 1	8.23	64.81	12.75	3.88
Week 2	7.04	65.73	13.58	2.52
Week 3	7.74	64.20	13.29	3.57
Week 4	6.24	64.13	13.46	3.47
Week 5	6.33	64.25	11.28	2.38
Average:	7.11	64.62	12.87	3.16

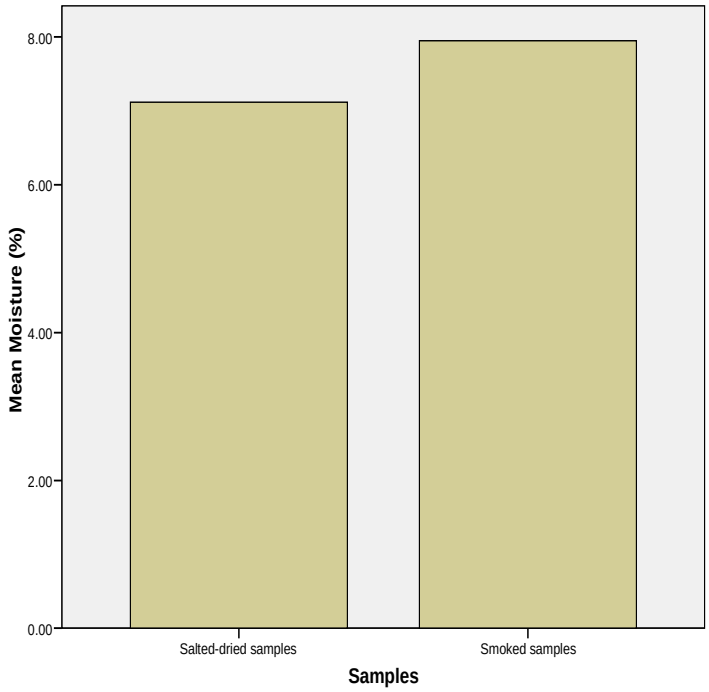

Figure 1: Percentage moisture of the salted and smoked products

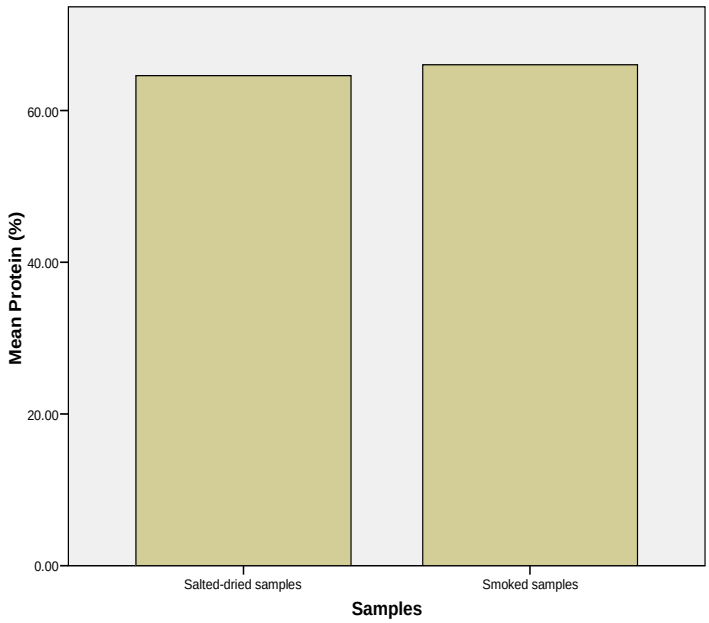

Figure 2: Percentage protein of the salted and smoked products

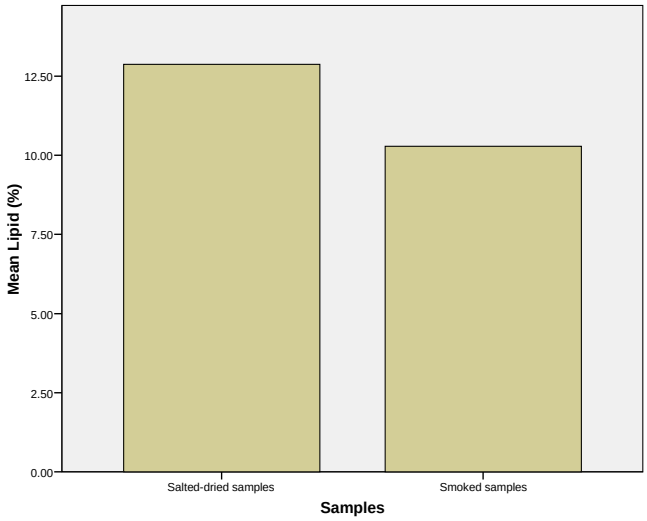

Figure 3: Percentage lipid of the salted and smoked products

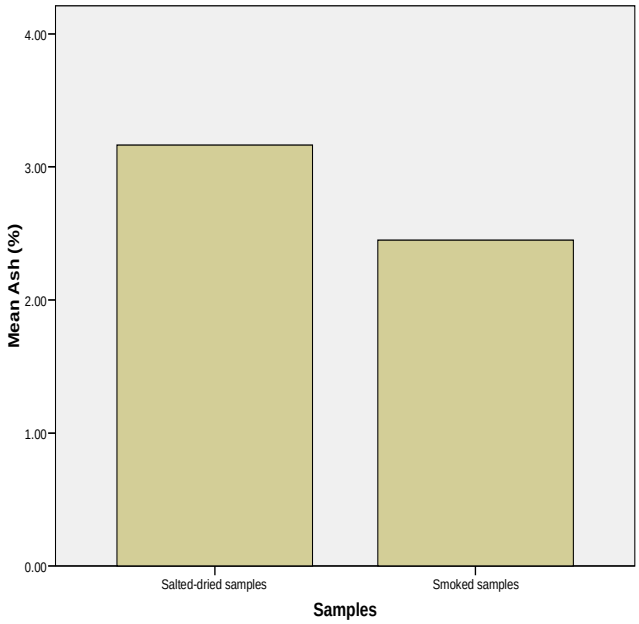

Figure 4. Percentage ash of the salted and smoked products

DISCUSSION

Protein is the major nutrient factor contributed by animals to human diet. Fish is a major supplier of this factor. Fish as a source of protein supplies protein of high class quality compared to protein of other animal sources. Fish is however a highly bio-perishable material postmortem. Different technologies, including the ones applied in this research have been used to preserve both the intrinsic and extrinsic qualities of fish soon after harvest. In this work therefore, an effort to find out which of these preservation methods; Smoking or Salting, ensures better proximate composition and shelflife.The weeky percentage moisture content of the smoked products ranged from 7.32 - 8.23, while that of salted-dried products ranged between 8.23 - 6.24. The two products were not significantly different from each other ($P>0.05$). However, while the moisture content of the Salted-Dried products was progressively decreasing, that of the smoked products was relatively increasing over the period of five weeks. The increase in moiture content of the smoked products could best be discribed as water reabsorption, which encourage microbial activity and hence spoilage in postmortem fish. If these opposing

trends continues over a period of time, spoilage due to microbial action will be more critical in the smoked products.

The preliminary percentage (%) proximate composition of the two products i.e, the smoke (SMKD) and the salted Dried (SLTD) stored for a period of five (5) weeks were in the following ranges 65. 23 – 66.86%, 7.32 – 8.39%, 8.61 – 12.69%, and 2.16 – 2.90% for protein, moisture, lipid and ash respectively for the smoked products while 64.13 – 65.73%, 6.24 – 8.23%, 11.28 – 13.58% and 2.16 – 2.90% for the protein, moisture, lipid and ash of the salted dried products.

The percentage protein cotent of the smoked products (SMKD) ranged from65.23 – 66.86%, while that Salted–Dried products ranged from64.13 – 65.73%. The mean percentage protein compostion at week five were 66.02% and 64.62% for the smoked and salted-dried products respectively. There was no significant difference between the products, (P> 0.05). The relative low protein level as recorded in the salted-dried products can be related to the high percentage of lipid, as demonstrated by figure

Tables 1, 2 and figures 1 and 2 shows that the percentage moisture and protein contents were relatively greater in the smoked products compared with the salted-dried products. There were however no significant differences in both the moisture and protein contents of the two products, (P> 0.05). This preliminary results showed a drop in the protein value over a relative short period of storage. This agreed with the findings of Abolagba and Osifor, 2004, who stated that protein decompses with passing time.

The percentage moisture observed was relatively higher and progressively increasing in smoked products, while the reverse was the case in respect of salted products. The increase in the moisture content of the smoked could be as a result of moisture reabsorption while in storage. Based on these characterisations, the smoked products were more proned to microbial spoilage, while the salted - dried products were proned to spoilage by oxidation of lipid which eventually will result to rancidity of the fish. This development tends to increase water activity and microbial growth eventual degredation of the protein and lipid values. Ames et tal., 1991, reported that when the water activity is considerably reduced, most microorganisms become inactive but haploidic microorganisms and xerophylic mould become the major causes of microbial spoilage. The relative lower percentage moisture of the Salted-Dried products could be as a result of the combined action effects of the salt and heat which enhanced greater dehydration.

Tables 1, 2 and figure 3 shows that the salted-dried products have greater percentage lipid. There was no significant difference between the lipid values of the two products, (P>0.05). There were fluctuations in the percentage lipids of the Salted-Dried products over the five weeks of storage. On the other hand, the percentage lipid of the smoked products which was relatively lower, was less prone to oxidative rancidity compared to the Dried-Salted products. The greater the percentage lipid, the more the possibility of oxidative rancidity.

The relevance of mineral elements in any diet cannot be overstressed. Minerals contribute essentialy to the metabolic processes. The percentage ash of the salted products as observed was relatively greater in the salted products but there were no significant difference in the percentage ash contents of the two products, (P>0.05). However, on the account of the application of salt, the salted products certainly accounted for more mineral salts.

CONCLUSION

From the result of this study, the proximate analysis showed that the smoked samples have greater nutritive value in terms of percentage crude protein. Also the effect of heat and dryness associated with the hot smoking reduces the water activity of the fish thereby limiting microorganisms, a prerequisite for spoilage. Fish processing by smoking recommended for use because it gives relatively greater percentage protein and mineral salt.

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Corresponding author
Ndakatu, M.A.,
Department of Water Resources, Aquaculture and Fisheries Technology, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State, Nigeria
E-mail: ndakatua@yahoo.com

T-Test

Group Statistics

	Sample	N	Mean	Std. Deviation	Std. Error Mean
Moisture (%)	Salted-dried samples	5	7.1160	.86910	.38867
	Smoked samples	5	7.9460	.41259	.18452
Protein (%)	Salted-dried samples	5	64.6240	.67482	.30179
	Smoked samples	5	66.0240	.65964	.29500
Lipid (%)	Salted-dried samples	5	12.8720	.94487	.42256
	Smoked samples	5	10.2880	1.69845	.75957
Ash (%)	Salted-dried samples	5	3.1640	.67092	.30004
	Smoked samples	5	2.4500	.29155	.13038

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Moisture (%)	Equal variances assumed	3.779	.088	-1.929	8	.090	-.83000	.43025	-1.82215	.16215
	Equal variances not assumed			-1.929	5.716	.104	-.83000	.43025	-1.89559	.23559
Protein (%)	Equal variances assumed	.010	.922	-3.317	8	.011	-1.40000	.42202	-2.37318	-.42682
	Equal variances not assumed			-3.317	7.996	.011	-1.40000	.42202	-2.37327	-.42673
Lipid (%)	Equal variances assumed	1.871	.209	2.973	8	.018	2.58400	.86919	.57964	4.58836
	Equal variances not assumed			2.973	6.259	.024	2.58400	.86919	.47835	4.68965
Ash (%)	Equal variances assumed	9.009	.017	2.182	8	.061	.71400	.32715	-.04041	1.46841
	Equal variances not assumed			2.182	5.459	.076	.71400	.32715	-.10615	1.53415