



Effects of Some Processing Methods on Organoleptic Properties and Proximate Composition of *Sarotherodon melanotheron*

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Abstract

The effects of different preservation methods (oven dried, fried and smoked) on the nutritional composition and organoleptic properties in black jaw tilapia, *Sarotherodon melanotheron* were carried out. All processing methods revealed significant difference ($p < 0.05$) in the various nutritional composition. Among the methods of preservation, smoked fish had the highest protein (64.66%), closely followed by dried fish. Comparative assessment on organoleptic qualities of oven dried, smoked and fried fish indicates that fried fish were preferred to the oven dried and smoked fish in terms of colour, flavor taste, and acceptability. While smoked fish was preferred in terms of texture. The study revealed that, smoked *S. melanotheron* has the highest nutritive value. Fried *S. melanotheron* was generally accepted based on taste and flavor. It is therefore recommended that *S. melanotheron* should be smoked or fried, because of their small sizes.

Keywords: *Sarotherodon melanotheron*; Aquaculture; Organoleptic Properties; Fish Production

Introduction

Nigeria is a maritime state of about 140 million people with a coastline measuring approximately 853 kilometers [1]. Out of the 36 states of the federation, nine are located on the coast where the waves of the Atlantic Ocean lap against the land [2]. With this scenario, the natural expectation is that Nigeria should not only be self-sufficient in fish production but should also be an exporter of aquatic foods. Nigeria once used to be self-sufficient in fish production. At the coastal regions and riverside dwellings, people used to engage in fishing as a major source of food and family income. The discovery of oil in commercial quantity however changed all that. Youths in the Niger Delta region took to oil-related activities in preference to fishing, fishing suffered as part of the general neglect of agriculture in the country [3].

In 1997 alone, for instance, Nigeria's fish demand

stood at 1.27 million metric tonnes. The domestic fish demand in 1998 was 1.52 million tones. Recently, demand for fish production has doubled as other sources of animal protein have become expensive due to pressure by the ever-increasing population and high production cost of the other animal protein sources [4]. Nigeria has become one of the largest importers of fish in the developing world, importing some 600,000 metric tonnes annually [5]. To solve the country's high demand for fish, Nigerians must turn to their underutilized inland water for improved fish production and Aquaculture. Aquaculture expansion, moreover, has been a slow process, as private sector fish farmers have faced major constraints, including lack of seed and quality food [6].

The importance of fish curing is that it slows down spoilage process in fish which is brought about by autolysis and bacterial decomposition. Some level of salt absorption by the fish, the bacterial growth and activity are arrested and

spoilage is prevented. Smoking is a popular processing method and nearly 45% of the fish catch is consumed in this form [7]. Smoke curing as applied to fish is a method of preservation effected by a combination of drying and the deposition of naturally produced chemicals resulting from thermal breakdown of wood. There are two main effects of smoking on fish: Firstly is the peculiar attractive flavor imparted and secondly is the better keeping quality of smoked fish when compared with wet fish [8]. The short period of curing to which the fish is subjected prior to smoking is mainly responsible for the increased keeping power. Smoking contributes to some extent to the inhibition of bacterial growth by extraction of moisture and deposition of antiseptics such as phenols [9]. The efficient smoking of fish results in the finished product having a dry and glossy appearance while possessing a most attractive aroma and flavor. Drying also reduces the moisture content of fish thereby extending the shelf stability of the fish. Fish smoking and drying are widely accepted both as a food as well as preservative method [10]. Processing of brackish fish species like the processing of other food raw materials should attain best possible market quality and price. The use of appropriate methods that will enhance its quality has become necessary and is of paramount importance.

The need to look at the effect of processing on the nutrient composition of fish is therefore high. This work is thus a preliminary investigation of the effect of some common processing methods-drying, frying and smoking on the macronutrient content and of *S. melanotheron*, a tilapia fish that is commonly consumed in Nigeria. This fish is one of the major source of animal protein for the average individual and family. Proximate composition generally comprises the estimation of moisture, protein, fat and ash contents of the fresh fish body. The percentage composition of these constituents amounts for about 96-98% of their total tissue constituents in fish. Biochemical composition of the whole body indicates the fish quality. Therefore, it is important to study the effects of boiling, frying and smoking on the proximate composition of *S. melanotheron*, a tilapia fish that is commonly consumed in Nigeria [11]. However, reports on the quality of *S. melanotheron*, marketed in Nigeria are limited. Hence the need for this study. The aim of this study is to assess the effect of smoking, frying and oven-drying on the organoleptic properties and proximate composition of *S. melanotheron*.

Materials and Methods

Material Procurement

Fresh brackish water specie *S. melanotheron* were obtained from Choba market, Choba in Obio-Akpor Local Government area of Rivers State and kept in sterile containers.

Sample Preparation

The procured fish samples were weighed and carefully cleaned to remove slime, blood and harmful bacteria. They were eviscerated followed by gills removal, leaving the skin on the fish. The fish were used whole because of their small size. After evisceration, and were placed in 80% brine solution for 5 minutes and thereafter salted and kept in sterile container.

Experimental Design

The experiment was a 3x3 completely randomized design, having three replicates with three processing methods.

Experimental Procedure

The fish samples were cleaned, de-gutted, dipped in brine water, spiced with condiments and divided into three parts of 3Kg each and labeled A, B, and C. Sample A were fried, Sample B were smoked dried, and Sample C were oven dried. Let her give some details of how she prepared the fish before frying, smoking and oven drying giving no room for bias in the preparation method.

Proximate Analysis

The proximate composition of the smoked fish samples were carried out in triplicates in accordance with the methods of AOAC [12]. Carbohydrate in the sample was calculated by 100 subtracted from all other parameter carry out [13].

Organoleptic Characteristics Assessment

Subjective analysis was used in the organoleptic characteristics analysis; students were used to perform the tests. Twelve members of the panel were selected to assess each fish products on aggregate based on

- Flavor,
- Texture,
- colour,
- Taste
- General Acceptability

Grading of Organoleptic Properties

Organoleptic properties were scored for each processed fish based on:

- Excellent→5 marks
- Very Good→4 marks
- Good→3 marks
- Poor→2 marks

- Very Poor→1 mark
- Not Acceptable→0 mark.

Statistical Analysis

The data generated from this work were expressed as mean \pm standard deviation. One way analysis of variance (ANOVA) were used to determine whether there was any significant difference ($P < 0.05$) between the mean of samples using the Statistical Package for Social Statistics (SPSS Version 22). Means were separated using the Tukey means separator.

Results

Analysis of fresh, oven dried, smoked and fried fish samples for their moisture level, ash content, crude fiber, crude protein, carbohydrate and fat is presented in Table 1. Percentage moisture revealed that fresh fish samples had the highest moisture level of 65.46%, followed by fried fish samples with 31.16% then oven dried fish (30.01%) while the smoked fish samples had the least moisture level of 25.67%. Highly significant difference ($P < 0.05$) was noted in moisture level among the fish samples. For % ash content, it was observed that fried fish had the highest ash content of 2.95% which was not significant from fresh fish with 2.43%, and followed by oven dried fish with ash content of 1.55% while smoked fish had the least ash content of 1.18%. Also, highly significant difference was observed in % ash content among the various preservation methods. Crude fibre level also revealed that fresh fish samples had the highest crude

fibre of 1.97% and was significantly difference ($P < 0.05$) from oven dried fish (1.04%), smoked fish (1.01%) and fried fish (1.22%). Although smoked fish had the least fiber content.

Percentage protein in the fish samples also revealed that the smoked fish had the highest protein level of 64.66%, closely followed by oven dried fish (62.71%), and then fried fish (48.94%) while fresh fish (24.15%) had the least protein level. The level of carbohydrate analyzed from the various samples showed that the fresh fish had the highest level of carbohydrate with 9.70% , followed by oven dried fish and smoked fish with 8.20% and 8.08% respectively. Meanwhile, the fried fish has the least carbohydrate level of 7.92% which was far lower than the others. Highly significant difference was noted among the preservation methods. Although, oven dried and smoked fish tends to have almost equal carbohydrate level. The level of fat was highly significant among the methods of preservation. . Fat level of the fish analyzed was observed to be highest in fresh fish having 42.65% fat, followed by fried fish with 31.50% while oven dried fish and smoked fish had 19.02% and 6.15% respectively (Table 1). The colour, flavor, texture, taste and general acceptability of the oven dried *S. melanotheron* significantly differed ($p > 0.05$) from that of smoked and fried fish samples. There was no significant differences ($p > 0.05$) in the color, flavor, texture, taste and general acceptability of the smoked and fried fish samples. The fried fish had the highest colour, flavor, taste and general acceptability than other processed fish. While in terms of texture, smoked fish had the highest score (Table 2).

| Parameters | Fresh Fish | Oven drying | Smoking | Fried Fish |
|----------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| % Moisture | 65.46 \pm 0.14 ^c | 30.01 \pm 0.13 ^b | 25.67 \pm 0.17 ^a | 31.16 \pm 0.44 ^b |
| % Ash | 2.43 \pm 0.03 ^b | 1.55 \pm 0.05 ^a | 1.18 \pm 0.03 ^a | 2.95 \pm 0.05 ^b |
| % Crude Fibre | 1.97 \pm 0.01 ^c | 1.04 \pm 0.00 ^a | 1.01 \pm 0.01 ^a | 1.22 \pm 0.00 ^b |
| % Protein | 24.15 \pm 0.09 ^a | 62.71 \pm 0.04 ^c | 64.66 \pm 0.08 ^c | 48.94 \pm 0.06 ^b |
| % Carbohydrate | 9.70 \pm 0.37 ^a | 8.20 \pm 0.13 ^b | 8.08 \pm 0.17 ^b | 7.92 \pm 0.08 ^a |
| % Lipid | 42.65 \pm 2.56 ^d | 19.02 \pm 1.23 ^b | 6.65 \pm 0.83 ^a | 31.50 \pm 2.99 ^c |

Means within the roll with different superscript are significantly different ($P < 0.05$)

Table 1: Proximate Composition in *S.melanotheron* Processed with Different Methods (Mean \pm SD).

| Properties | Oven drying | Smoking | Fried Fish |
|-----------------------|-------------------------------|-------------------------------|-------------------------------|
| Colour | 3.93 \pm 0.38 ^a | 4.07 \pm 0.85 ^b | 4.36 \pm 0.87 ^b |
| Flavor | 3.58d \pm 0.52 ^a | 4.03b \pm 0.49 ^b | 4.80 \pm 0.72 ^c |
| Texture | 3.53d \pm 0.57 ^a | 4.87b \pm 0.52 ^c | 4.09a \pm 0.64 ^b |
| Taste | 3.62d \pm 0.45 ^a | 4.07 \pm 0.74 ^b | 4.89 \pm 0.85 ^c |
| General Acceptability | 3.96d \pm 0.66 ^a | 4.04b \pm 0.84 ^b | 4.88a \pm 0.73 ^c |

Means within the roll with different superscript are significantly different ($P < 0.05$)

Table 2: Organoleptic Properties in *S. melanotheron* Processed with Different Methods (Mean \pm SD).

Discussion

Moisture, Proteins, and lipids contents were the major constituents, which had been considered in evaluating the nutritional value of the fish studied. The nutritional elements showed variable values in the fish analyzed; with moisture recording the highest values and crude fiber recording the lowest. The fish examined belonged to high protein (15 to 20%). The low ash, carbohydrate, crude fiber, fat, high protein and moisture content values obtained from the proximate analysis agreed with other analysis carried out by earlier researchers [14-16]. The moisture content of the dried fish which is of great importance in storage is still at safe level [17]. The significant increase in protein levels ($P < 0.05$) in fried, smoked and oven dried fish when compared with the fresh fish, suggested that protein nitrogen was concentrated during drying, smoking and frying. This is also in accordance with the findings of Puwastien P, et al. [18] and Tao W, et al. [19].

Fishes with fat content of above 5% are considered not lean [20]. Drying, frying and smoking reduced ($p < 0.05$) the moisture content of the fish samples. These may be because drying, smoking and frying temperature was higher than the boiling point of water. Thus reduction in moisture content in both will improve the quality of the fishes for longer preservation time, because low moisture levels in fish reduces the fishes' susceptibility to microbial spoilage and oxidative degradation of polyunsaturated fatty acids [21]. Ash is a measure of the mineral content of food item. It is the inorganic residue that remains after the organic matter has been burnt off [22], the increase in ash with processing indicates that the fish is a good source of minerals. The levels of crude fibre in the fish ($p < 0.05$) was low, and decreased considerably with processing compared with the raw sample. Crude fibre is responsible for ease of bowel movement [23].

Comparative assessment on organoleptic qualities of oven dried, smoked and fried fish indicates that fried fish were preferred to the oven dried and smoked fish in terms of colour, flavor taste, and acceptability. While smoked fish was preferred in terms of texture. Preference in colour, taste, flavour, and acceptability could be attributed to the processing method (frying) which might add nutrient to the fish [24]. Agbabiaka LA, et al. [25] reported that the oil used for fish processing (frying method) might contain natural chemical compounds which are responsible for the pleasurable taste, colour and flavour in fried products. The finding of the present study is in agreement with the report of Kallon A, et al. [26], who obtained similar result when comparing organoleptic qualities, production and economics of smoked fish and solar dried fish in Sierra Leone artisanal fishing industry.

Conclusion and Recommendations

The study revealed that, smoked *S. melanotheron* has the highest nutritive value. Fried *S. melanotheron* was generally accepted based on taste and flavour. Moisture, Proteins and lipids contents were the major constituents, which had been considered in evaluating the nutritional value of the fishes studied. The nutritional elements showed variable values in the fishes analyzed; with moisture recording the highest values and lipid recording the lowest. All the processing methods are equally good as they could help in extending the shelf life of the fish products, with an exception of boiling method. These methods could keep the fish products free from spoilage microorganisms attack for some time. It is therefore recommended that *S. melanotheron* should be smoked or fried, because of their small sizes.

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